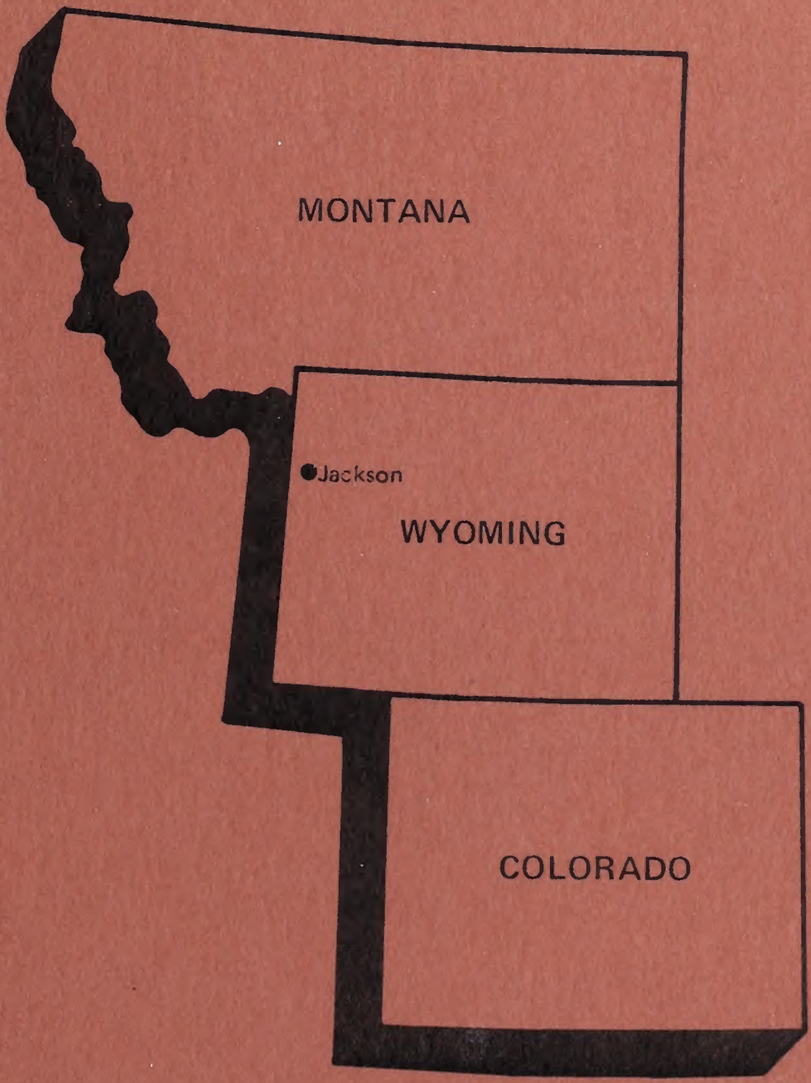
BLM LIBRARY
88072213

Proceedings of the Rocky Mountain Regional

Soil-Water-Air Resource Meeting



Jackson, Wyoming
February 2-6, 1981

S
932
.A145
R68
1981

#9838043

ID: 88072213

S
932
.A145
R68
1981

PROCEEDINGS OF THE ROCKY MOUNTAIN REGIONAL SOIL-WATER-AIR MEETING

February 2 - 6, 1981

Sponsored by:
The Bureau of Land Management
Wyoming State Office

Cooperating Offices:
1. BLM - Colorado State Office
2. BLM - Montana State Office

Eric James	Hydrologist	BLM	Denver, CO
Al Galbrath	Hydrologist	USFS	Jackson, WY
Phyllis Roseberry	Range Scientist	BLM	Cheyenne, WY
Dave Sturgis		USFS	Laramie
Bill Wagner	Air Quality Specialist	BLM	Salt Lake
Ken Harrison	Chief, Br. Planning	BLM	Cheyenne, WY
Bruce Keating	Remote Sensing Coord.	BLM	Cheyenne
Glen Rose	Fire & Safety Officer	BLM	Cheyenne, WY
Vern Webb	Soil Scientist	BLM	Coeur d'Al

[illegible]
[illegible]

[illegible]

[illegible]
[illegible]

[illegible]
[illegible]
[illegible]

Soil, Water, and Air Workshop Attendees
Jackson, Wyoming

Name	Position	Agency	Location
Richard Inglis	District Hydrologist	BLM	Craig, CO
Philip Allard	District Soil Scientist	BLM	Craig, CO
Bill Ypsilan	District Soil Scientist	BLM	Montrose, CO
Dennis M. Murphy	Hydrologist	BLM	Montrose, CO
Bob Long	RA Soil Scientist	BLM	Rawlins, WY
Steve Strenger	Overland RA Soil Scientist	BLM	Rawlins, WY
Greg Bautz	Division of Resources Soil Scientist	BLM	Rawlins, WY
Marc Beroz	Division of Resources Soil Scientist	BLM	Casper, WY
Mike Brogan	District Hydrologist	BLM	Casper, WY
Mike Whittington	Hydrologist	BLM	MSO, Billings, MT
Dan Muller	Hydrologist	BLM	Lewistowon DO
Earl L. Neff	Research Hydrologist Engineer	USDA-SEA-AR	Sidney, MT
J. D. Peterson	Physical Scientist	BLM	MSO, Billings
Jack Kelly	Chief, Resources	BLM	Rawlins, WY
Royal G. Holl	Natural Resource Spec.	EPA (BLM)	Denver, CO
Jim Hagihara	Research Management	BLM	Fort Collins, CO
Howard Wertsbaugh	District Hydrologist	BLM	Canon City, CO
Bill Holub	Hydrology Technician	BLM	Canon City, CO
Bob Addison	District Soil Scientist	BLM	Canon City, CO
Mel Clansen	District Manager	BLM	Canon City, CO
Tom Yochem	Hydrologist	BLM	Billings, MT
Gary Rosenlieb	District Hydrologist	BLM	Worland, WY
Chuck Neal	Soil Scientist	BLM	Worland, WY
Stan Coloff	A. Q. Specialist	BLM	Washington, D. C.
Bill Eikenberry	ASD	BLM	Cheyenne, WY
Bill LeBarron	Chief, Division of Res.	BLM	Worland, WY
Chad McBurney	Chief, Biological Res.	BLM	Cheyenne, WY
John Kwiatkowski	District Manager	BLM	Worland, WY
Mike Rollins	Soil Scientist	BLM	MSO, Billings
Rich Herbert	CO State Hydrologist assigned to USGS	USGS	Denver, CO
Collis Lovely	Hydrologist	BLM	220 - Washington
Milt Schloss	Senior Hydrologist	BLM	211 - Washington
Colin Voight	Soil Scientist	BLM	Rock Springs, WY
Steve Hamp	Hydrologist	BLM	Rock Springs, WY
Jeff Villnow	Hydrologist	BLM	Rock springs, WY
Dick Larsen	Soil Scientist	BLM	Rawlins, WY
Renee LaNiolette	District Soil Scientist	BLM	Rock Springs, WY
Tom Lukow	Air Quality Specialist	BLM	Cheyenne, WY
Cliff Franklin	Hydrologist	BLM	Cheyenne, WY
Ross Wright		USDS - ARS	Boise, ID
Mike Stone	Fishery Biologist	WY G&F	Cheyenne, WY
Bill Crane	Soils Scientist	BLM	Cheyenne, WY
Bo Stuart	Hydrologist	USFS	Jackosn, WY

Eric Janes	Hydrologist	BLM	Denver, CO
Al Galbrath	Hydrologist	USFS	Jackson, WY
Phyllis Roseberry	Range Scientist	BLM	Cheyenne, WY
Dave Sturgis		USFS	Laramie
Bill Wagner	Air Quality Specialist	BLM	Salt Lake City, UT
Ken Harrison	Chief, Br. Planning	BLM	Cheyenne, WY
Bruce Keating	Remote Sensing Coord.	BLM	Cheyenne, WY
Glen Rose	Fire & Safety Officer	BLM	Cheyenne, WY
Vern Webb	Soil Scientist	BLM	Coeur d'Alene, ID

Watershed Meeting

Evaluation

February 2 - 6 1981

Summary Response: 28 of 52 participants--Rocky Mountain Regional SWA Meeting

1. How many years, including this one, have you attended the Watershed meeting?
1=22
2=1
3=1
5+=4

2. In general, do you approve the traditional format and program of the meeting?

21 Yes 4 No 2 Maybe

3. Would you like more emphasis on (check one):

a. 14 Practical field information?

b. 5 Information about issues of national concern?

c. 9 Assistance in strengthening District operations?

d. 9 Other items - Specify: a. SWA interpretations b. Regional concerns c. Keep a balance of above

4. Would you suggest (check one):

a. 7 More time for tours or other opportunities to view S, W, & A programs?

b. 5 More "workshop type" concurrent sessions?

c. 18 More opportunity for audience participation and idea exchange?

d. 4 Other - Specify: All of above

e. 5 Outside speaker - other agency techniques?

5. Should the meeting (check one):

a. 0 Last longer than at present?

b. 5 Be shorter than at present?

c. 15 Remain about the same?

d. 0 Discontinue meeting?

e. 18 Continue annually?

6. Would you prefer the meeting be held at (check one):

a. 2 A metropolitan location?

b. 16 A resort area?

c. 0 A State Office?

d. 10 A university facility?

e. 6 No preference.

7. Do you like a tour (check one):

a. 0 Prior to the meeting?

b. 1 After the meeting?

c. 13 Mid week?

d. 14 No preference.

8. Recommended future meetings:
1. Resort area
2. Expermental stations

9. In what area of S, W, & A do you feel the Bureau is deficient?
1. Training
2. Manual guidance
3. Standardization of methods
4. Manpower

10. Other comments and recommendations:
1. Develop more flexible schedule
2. Need more "bull" sessions
3. Good idea to involve management
4. Need more technical subjects

Overall Summary

1. Good session
2. Morale boost to field offices to see DSC and WO involvement
3. Good mix of subjects.

Rocky Mountain Regional Soil, Water, and Air Resource Workshop

Jackson Hole, Wyoming
February 2-6, 1981

Coordinator: Tom Lukow (WSO 930)

Monday, Feb. 2 Session Chairman: Tom Lukow

1:00-1:15	Welcome, Announcements, Objectives	WSO
1:15-1:45	Welcome Address	B. Eikenberry, ASD, Wyoming
1:45-2:30	Resource Management Planning (RMP)	K. Harrison (WSO 920)
2:30-3:15	Aerial Photography/Remote Sensing: Tools for Soil, Water, and Air Resource Management	B. Keating (WSO 940)
3:15-3:30	Break	
3:30-4:30	Soil, Water, Air Program Overview (Air portion located in Tuesday's reports)	C. Lovely (WO 220) M. Schloss (WO 211) S. Coloff (WO 202)
4:30-5:15	Interagency Resource Evaluation Techniques Program	J. Hagihara BLM Ft. Collins

Tuesday, Feb. 3 Session Chairman: Chadwick McBurney, WSO 930

8:00-8:45	Management Perspective on Accomplishments and Shortcomings of the BLM Soils Program	J. Kelly Rawlins Dist., Wyoming
8:45-9:30	Mud Pit Farming	J. Kwiatkowski Worland Dist., Wyoming
9:30-10:15	Kinds of Interpretations from an Order 2 Soil Survey (paper not submitted)	C. Voigt Rock Spgs. Dist., Wyoming
10:15-10:30	Break	
10:30-11:15	Management Perspective on Accomplishments and Shortcomings of the BLM Hydrology Program	M. Clausen Canon City Dist., Colorado
11:15-12:00	Rangeland Hydrology in the BLM	C. Lovely (WO 220)
12:00-1:00	Lunch	
1:00-1:45	Water Rights Program in the BLM	M. Schloss (WO 211)
1:45-2:15	Management Perspective on the Air Resource Program (paper not submitted)	C. McBurney (WSO 930)
2:15-3:00	Air Resource Management Update	S. Coloff (WO 202)
3:00-3:30	Break	
3:30-4:15	Air Quality Considerations in Federal Land Management--The Clean Air Act Amendments (1977)	S. Coloff (WO 202) T. Lukow (WSO 930)
4:15-5:00	Visibility: Its Basis in the Clean Air Act, Regulatory Status, and Implications to BLM	T. Lukow (WSO 930)

Wednesday, Feb. 4 Session Chairman: Tom Lukow, WSO 930

8:00-8:30	Contour Furrowing and Treatment of Depleted Rangeland	E. Neff Sidney, Mont. USDA/SEA
8:30-9:00	Modeling for Forage Forecasting	R. Wight Boise, Idaho USDA/SEA
9:00-9:15	Work Group Assignments	T. Lukow (WSO 930)
	Water Resources Group Chairman	R. Herbert BLM/USGS
9:15-10:00	Field Water Rights Inventory in Colorado	H. Wertsbaugh Canon City Dist., Colorado
10:00-10:15	Break	
10:15-11:00	Flood Plain Management	M. Schloss (WO 211)
11:00-12:00	Hydrology and Watershed Inventories	C. Lovely (WO 220)
12:00-1:00	Lunch	
1:00-1:45	Instream Flow Surveys in Wyoming	M. Stone Wyo. Game & Fish Dept.
1:45-2:30	208 Review and Update	R. Holl BLM/EPA
2:30-3:00	Break	
3:00-3:45	Water Quality and Wildland Resource Management	A. Galbrath USFS/Bridger-Teton NF
3:45-6:30	Problems and Issues Discussion (open session)	Water Group attendees

Wed., Feb. 4 (Cont.)

Soils Resources Group Chairman Chuck Neal
Worland Dist., Wyoming

9:15-10:45	Work Assignment Records (WAR)	R. Clark (DSC 460)
10:45-11:00	Break	
11:00-12:00	Soil Characterization and Production Potential	M. Rollins (MSO 930)
12:00-1:00	Lunch	
1:00-2:00	Fire Rehabilitation Guidance	G. Rose (WSO 940)
2:00-3:00	SVIM Data Interpretations	R. Clark (DSC 460)
3:00-3:30	Break	
3:30-4:30	208 Water Planning (see Water session) BLM/EPA	R. Holl

Air Resource Group Chairman S. Coloff
(WO 202)

9:15-4:30	Air Resource Program Orientation (A Suggested Outline)	

Thursday, Feb. 5	Session Chairman	Tom Lukow (WSO 930)
8:00-8:45	Procedures for Submitting Research Proposals	P. Roseberry (WSO 930)
8:45-9:45	Rangeland Soil Erosion (USLE) (PSIAC) (SSF)	C. Lovely (WO 220)
Water Resource Group	Chairman	M. Whittington (MSO 930)
9:45-10:30	Red Creek Watershed Management Plan	S. Hamp Rock Spgs. Dist., Wyoming
10:30-11:00	Break	
11:00-11:30	Sediment Control by Structural Means in Fifteenmile Creek - An Overview	G. Rosenlieb Worland Dist., Wyoming
11:30-12:30	Livestock Grazing Management and Water Quality Protection	E. Janes (DSC 450)
12:30-1:45	Lunch	
1:45-2:30	BLM-USGS Flood Routing Study in the Willow Creek Basin	D. Muller Lewiston Dist., Mont.
2:30-3:00	Break	
3:00-3:30	SVIM Data Interpretations (see Soils session)	R. Clark (DSC 460)
3:30-4:00	BLM/USGS Exchange Program	R. Herbert USGS
4:00-4:30	Status of Rainfall Simulation and Saval Ranch Project Overview	E. Janes (DSC 450)

Thursday, Feb. 5 (Cont.)

Soils Resources Group	Chairman	M. Rollins (MSO 930)
9:30-10:30	Soil Interpretations	V. Webb Coeur d'Alene Dist Idaho
9:45-12:00	Soils Resource Information System (User Oriented)	D. Anderson SCS K. Stephenson CU
12:00-1:00	Lunch	
1:00-1:45	DSC Organization and Research Information Sources	J. Stone (DSC 450)
1:45-2:30	Remote Sensing and Inventories (paper not submitted)	J. Hagihara BLM Ft. Collins
2:30-3:00	Break	
3:00-3:45	Interagency Soil Topics of Interest	J. Chugg (WO 220)
3:45-4:30	Ecosystem Approach to Stream Habitat Management	B. Smith Rock Spgs. Dist., Wyoming
Air Resource Group	Chairman	T. Lukow (WSO 930)
9:00-4:30	Review of and Comments on the National Park Service Preliminary List of Integral Vistas (published in CFR 1/15/81) (Workgroup assignment)	

Friday, Feb. 6	Session Chairman	C. Franklin (WSO 930)
8:00-8:45	Discussions of Function and Programs of Division of Special Studies	E. Janes (DSC 450)
8:45-9:00	The Objectives and BLM Participation in the NADP BLM's Role in the Identification of Air Quality Related Values (AQRV's)	J. Peterson (MSO 930)
9:00-9:15	Ecosystem Approach to Stream Habitat Management	B. Smith Rock Spgs. Dist., Wyoming
9:15-9:30	Break	
9:30-10:30	Snow Management in Rangelands	D. Sturgis USFS
10:30-11:00	Reports from the Soil, Water, and Air Workgroups - Wrap Up	

Meeting Objectives

To allow interaction between line and staff personnel on soil, water, and air issues,

to assure that personnel are up to date on new legislative requirements and Bureau SWA policies and procedures,

to develop new techniques and recommendations to be used Bureauwide,

to introduce selected new procedures and technology relevant to SWA for protection and use of resources,

to involve all levels of the organization in providing technical input for updating policy and manual guidance,

and to assess the need for future SWA meetings.

Disclaimer

The opinions and views expressed in these presentations may, or may not, reflect the policies and procedures of the Bureau of Land Management. The contents are the sole responsibility of the individual authors, and, as such, the Bureau will not guarantee the quality of the data or the validity of the comments presented. All questions or comments should be directed to the individual authors.

PRESENTATIONS MADE ON

MONDAY, FEBRUARY 2, 1981

AND WHERE NECESSARY, CORRECTIVE ACTION -- WITH AN EYE TOWARD FUNCTIONAL, PRACTICAL APPLICATION AND PROCEDURALLY SOUND IMPLEMENTATION OF THE LEGISLATIVE MANDATES.

EVEN THOUGH THIS IS A WORKSHOP, I SUGGEST THAT YOU GO BEYOND A DISCUSSION OF THE ISSUES IN A CONVENTIONAL SENSE AND IDENTIFY WAYS IN WHICH OUR EXISTING ORGANIZATION CAN BETTER ACCOMMODATE FUTURE BUREAU NEEDS. LOOK AT WHAT WE HAVE, WHAT OUR NEEDS AND SHORT TERM GOALS ARE; THEN REACH BEYOND TO IDENTIFY WHAT ELSE CAN BE ACCOMPLISHED WITH THE RESOURCES WE HAVE. [illegible] WAYS THAT WE MIGHT BETTER AND MORE EXPEDITIOUSLY CARRY OUT OUR LONG-TERM GOALS AND OBJECTIVES. AS YOU DISCUSS THE [illegible] PROGRAM, FOR EXAMPLE, LOOK BEYOND TO CONSIDER HOW WE CAN MORE FULLY UTILIZE THE [illegible] DATA THAT WE HAVE [illegible] COLLECTED [illegible] [illegible] YEARS. IT SURELY HAS BROADER APPLICATION [illegible] [illegible] AND TO MEET A COURT-FORCED [illegible] SCHEDULE.

I [illegible] THAT YOU TAKE A GOOD LOOK AT OUR AIR RESOURCE [illegible] [illegible] [illegible] IN THE AREA OF AIR QUALITY [illegible] [illegible] MISUNDERSTOOD PROGRAM AREAS [illegible]

[illegible] VERY GOOD PEOPLE HERE FROM THE [illegible] AND AGENCIES TO DISCUSS THE AIR RESOURCE PROGRAM AND I WOULD EXPECT [illegible] POSITIVE RESULTS SURFACING FROM YOUR ACTIVITIES OVER THE NEXT SEVERAL DAYS. [illegible] AIR RESOURCE PROGRAM EFFECTIVE [illegible] [illegible] OBJECTIVES [illegible]

COMMENTS GIVEN TO SOIL, WATER, AIR CONFERENCE, JACKSON, WYOMING - 2/2/81 - F. WILLIAM EIKENBERRY, ASD

IT IS INDEED A PLEASURE TO WELCOME ALL OF YOU TO THE ROCKY MOUNTAIN REGIONAL SOIL, WATER AND AIR RESOURCE WORKSHOP. I ESPECIALLY WANT TO WELCOME OUR FRIENDS FROM OTHER AGENCIES AND FROM THE STATES OF COLORADO AND MONTANA THAT ARE WITH US HERE TODAY; AS WELL AS THOSE OF YOU FROM THE WASHINGTON OFFICE. A REALLY GOOD MIX OF PEOPLE WITH CONSIDERABLE EXPERTISE DEALING WITH A IMPRESSIVE RANGE OF RESOURCE ISSUES. LOOKING OVER THE AGENDA REALLY BRINGS HOME THE MAGNITUDE AND DIVERSE NATURE OF OUR PROGRAM. I AM CONFIDENT THAT AN EXCHANGE OF INFORMATION AND A GOOD DISCUSSION OF THE ISSUES WILL YIELD RESULTS THAT WILL SUBSTANTIALLY BENEFIT BLM PROGRAMS IN GENERAL.

I URGE, HOWEVER, THAT AS YOU DISCUSS THE ISSUES OVER THE NEXT FEW DAYS (AND BELIEVE ME, IT'S AN AMBITIOUS SCHEDULE) THAT YOU WILL NOT ONLY EXCHANGE INFORMATION, BUT WILL UNIFY AND FOCUS ON THE FACTORS FOR RESOLUTION OF EXISTING SOIL, WATER AND AIR PROBLEMS. I ASK THAT YOU DEVELOP PROPOSALS AND RECOMMEND REFORMS IN SOME OF THESE CRUCIAL AREAS OF BLM CONCERN.

AS A RESULT OF THE IMPLEMENTATION OF FLPMA AND OTHER DEMANDING PIECES OF LEGISLATION, WE HAVE BEEN INUNDATED WITH REGULATIONS, GUIDELINES, DIRECTIVES, ETC. THAT ARE OFTEN CONFUSING AND AT TIMES CONTRADICTORY. I URGE THAT YOU SORT OUT SOME OF THESE AREAS OF CONFLICT AND OFFER CONSTRUCTIVE RECOMMENDATIONS FOR CLARIFICATION

AND WHERE NECESSARY, CORRECTIVE ACTION -- WITH AN EYE TOWARD FUNCTIONAL, PRACTICAL APPLICATION AND PROCEDURALLY SOUND IMPLEMENTATION OF THE LEGISLATIVE MANDATES.

EVEN THOUGH THIS IS A WORKSHOP, I SUGGEST THAT YOU GO BEYOND A DISCUSSION OF THE ISSUES IN A CONVENTIONAL SENSE AND IDENTIFY WAYS IN WHICH OUR EXISTING ORGANIZATION CAN BETTER ACCOMMODATE FUTURE BUREAU NEEDS. LOOK AT WHAT WE HAVE, WHAT OUR NEEDS AND SHORT TERM GOALS ARE, THEN REACH BEYOND TO IDENTIFY WHAT ELSE CAN BE ACCOMPLISHED WITH THE RESOURCES WE HAVE. IN ORDER THAT WE MIGHT BETTER AND MORE EXPEDITIOUSLY CARRY OUT OUR LONG TERM GOALS AND OBJECTIVES. AS YOU DISCUSS THE SOILS PROGRAM, FOR EXAMPLE, LOOK BEYOND TO CONSIDER HOW WE CAN MORE FULLY UTILIZE THE SVIM DATA THAT WE HAVE SO DILIGENTLY COLLECTED OVER THE PAST SEVERAL YEARS. IT SURELY HAS BROADER APPLICATION THAN TO PREPARE EIS'S AND TO MEET A COURT-FORCED EIS SCHEDULE.

I ASK THAT YOU TAKE A HARD LOOK AT OUR AIR RESOURCE PROGRAM IN BLM AND IDENTIFY NEEDS AND VOIDS THAT MUST BE DEALT WITH IN ORDER TO MEET LONG TERM MANAGEMENT GOALS . . . PARTICULARLY, IN THE AREA OF AIR QUALITY MODELING . . . UNQUESTIONABLY ONE OF THE MOST MISUNDERSTOOD PROGRAM AREAS IN BLM.

THERE ARE SOME VERY GOOD PEOPLE HERE FROM THE VARIOUS STATES AND AGENCIES TO DISCUSS THE AIR RESOURCE PROGRAM AND I WOULD EXPECT SOME POSITIVE RESULTS SURFACING FROM YOUR ACTIVITIES OVER THE NEXT SEVERAL DAYS. OUR AIR RESOURCE PROGRAM OBJECTIVES ARE SOMEWHAT VAGUE AND NEED TO BE MORE CLEARLY DEFINED AND A GOOD DISCUSSION OF LONG TERM OBJECTIVES WOULD BE A VERY WORTHWHILE PART OF YOUR DISCUSSIONS.

Within this same context, take a hard look at water, in particular, "water rights." We have some people here from the Director's office that will no doubt bring us up-to-date on water rights considerations. We look forward to a status report and to a good discussion of our own concerns.

We have been advised just last week that our past Solicitor withdrew an earlier Solicitor's opinion regarding non-reserve water rights.

I suggest that as you discuss the water resource issues - and there are many which should lead to very good discussions in a number of areas - take a look at the ramifications of what this new water rights opinion really means to BLM and what impacts it may have in meeting Congressionally mandated programs - particularly, those dictated by FLPMA.

In summary, and to reemphasize, as you exchange information, review programs and examine and discuss new procedures and legislative requirements, take that next step and vigorously examine program areas that may need major adjustments. I ask that you identify those needs and propose changes that you perceive as necessary that will accommodate our needs not only now, but within the longer term context of our program.

Thank you very much and good luck over the next several days.

Resource Management Planning (RMP)

Ken Harrison - Wyoming State Office

Topic consisted of a brief description of the "old" planning system and components, the Resource Management Plan process and components, and the transition period between the two. The 12 planning principles laid out in FLPMA and the nine major required actions identified in the planning regulations were covered. Time frames relative to the two processes were discussed as was the plan amendment process.

Remote Sensing and Aerial Photographic Interpretation Tools to Support the Soils, Water, and Air Bureau Programs

Bruce Keating
Soil, Water, Air Meeting
February 2-6, 1981
Jackson, Wyoming

A. The presentation started with a demonstration of the types of imagery available for support of the soils, water, and air programs, including LANDSAT, National High Altitude Program, BLM's Cyclic Resource Photography, and Special Project Aerial Photography. Examples and handouts were given for the best scales and types of imagery for particular projects; i.e., 1:24,000 scale natural color aerial photographs for Order III soil inventories and color IR photography for surface water inventories.

B. Current aerial photographic coverage for Colorado, Montana, and Wyoming were depicted with viewgraphs and handouts. Costs and sources of existing aerial photography were indicated.

C. An explanation of orthophotoquads and their usefulness for resource inventories and as a mapping base was discussed. Emphasis was placed on the importance of capturing data in its current geographic position for future digital computer resource information systems.

D. The State Office's and Denver Service Center's capabilities for imagry/photo interpretation assistance were covered. The Bureau's remote sensing and aerial photographic interpretation training courses were identified.

E. In conclusion, dual slide projection was used to demonstrate the resolution of various Bureau aerial photography and to emphasize the large amounts of data available in an aerial photograph.

ROCKY MOUNTAIN REGIONAL
SOIL, WATER AND AIR RESOURCE WORKSHOP
JACKSON HOLE, WYOMING
FEBRUARY 2, 1981

JACK C. CHUGG, SOIL SCIENTIST
DIVISION OF RANGELAND MANAGEMENT
WASHINGTON, D.C.

NEW WATERSHED PROGRAM THRUSTS AND RESPONSIBILITIES

- Bureau's goal for the completion of the onceover soil inventory is 1989. This is a National responsibility (FLPMA).
- Bureau should publish all the soil inventories that meet the standards of the National Cooperative Soil Survey. Responsible for all parts of the report except correlation and cost of actual publication. (Increase credibility for the Bureau).
- USLE as a prediction model for quantifying sediment yield in Tons/AC/Yr. New concept for the Bureau. Estimate Erosion Workshop, Tucson - March 3-5, 1981
- Soil interpretation that the Bureau needs that the SCS does not supply in their interpretations. Up grade of existing interpretations. This is a responsible Technology advancement.
- Soil-Range Site Correlation

  Range Site Number

  Range Site Name

  Soil Vegetation - Climate Study (Interagency)

  Taxonomy For Plant Community
- Soil, Water and Air Resource Data Base in the planning system for Watershed Management
- Soil, Water and Air Resource Data Base for Environmental Statements, activity planning as well as a base for monitoring. This is the base for measuring change.

ROCKY MOUNTAIN REGIONAL MEETING
SOIL, WATER AND AIR RESOURCE WORKSHOP
JACKSON HOLE, WYOMING
FEBRUARY, 2, 1981

Jack C. Chugg, Soil Scientist
Division of Rangeland Management
Washington, D.C.

INTERAGENCY SOIL TOPICS OF INTEREST

- Soil - Vegetation - Climate Study Team (SCS, BLM, FS, SEA)

Results of November meeting were favorable

Study plan will be developed by BLM for consideration by other agencies

- Western Regional Meeting of the National Cooperative Soil Survey - San Diego, California - February 1-5, 1982

"The role of Soil Surveys in Land-Use Planning" (BLM, SCS, National Aspects)

Steering Committee

Chairman, Chuck Goudy
Co-Chairman, Jim Stone
Members:
Jack Chugg, BLM
Dick Kover, SCS
Fred Peterson, Univ. of NV, Reno, NV.

-- Soils Manual 7100 - Eventual Incorporation into the National Soil Handbook, starting with policy statements. This will take about one year.

- National Assessment (BLM, SCS, FS, SEA)

3/81 4-agency statement on coordination of policy, management planning, and program development actions at the National, Regional, State and local levels

- Soil Survey Manual

Chapters are coming as notices in the NSH, the BLM will have input into the range and Forest sections.

ROCKY MOUNTAIN REGIONAL
SOIL, WATER AND AIR RESOURCE
JACKSON HOLE, WYOMING
FEBRUARY 5, 1981

ITS PURPOSE AND USES; POLICY AND PROCEDURES

JACK C. CHUGG, SOIL SCIENTIST
DIVISION OF RANGELAND MANAGEMENT
WASHINTON, D.C.

The Mandates through legislative Acts have set the course for resource Inventory of the natural resource for the Bureau: FLPMA for instance, states "the Secretary shall prepare and maintain on a continuing basic for inventory of all public lands and other resources and other values . . . ., giving priority to areas of critical environmental concern. This inventory shall be kept current so as to reflect change in condition and identify new and emergency resource and other values" (Sec. 201). Further along in Section 202, the act becomes more specific. It reads, (1) "Use and observe the principles of multiple use, (2) use a systematic interdisciplinary approach to achieve integrated consideration of physical, biological, economic, and other sciences; and (3) coordinate with other Federal and State agencies in land use inventory, planning and management."

This act and others has caused the Bureau to enter into a costly inventory program for soils and vegetation and other resources to meet the requirements of legislative and legal actions.

In 1978, the Bureau entered into a Memorandum of Understanding for Soil Surveys on the Public Lands with the Soil Conservation Service and Forest Service. At that time the Bureau became a member of the National Cooperative Soil Survey (NCSS) with a voting membership of one. In 1980, this number was increased to include the State representatives as well as the Service Center and National office representatives of the Bureau. This gave the Bureau an opportunity to have considerable influence on the standards within NCSS.

The National Cooperative Soil Survey has a reputation for reliable basic data--and it is becoming increasingly efficient at supplying better data faster---because it is truly a cooperative effort between agencies, especially with the Soil Conservation Service. The work of experiment stations and Federal reserve scientists provides a very necessary support for this National program, other Federal and State agencies make a vital contribution to specific soil and vegetation inventories.

The purpose of the National Cooperative Soil Survey program is to make soil inventories to obtain an inventory of the Nation's soil resources; record the location of soils predict soil behavoir under defined use and management; enable the transfer of soil information from place to place; and fundamentally, contribute to the knowledge and understanding of our land resources. These are familiar words to the soil scientist and are or will become familiar to the users of the soil inventory.

Soil inventories are made to meet the needs of users in individual areas. To meet these needs, soil inventories or parts of soil inventories are made using different intensities of field investigations and levels of refinement for presenting information.

soil inventories of individual areas are designed by interdisciplinary group with knowledge of the specific uses for which the inventory is being organized and funded.

Soil inventories provide information for such uses as:

- Production of food and fiber,
- Determination of allowable soil losses and control of erosion,
- Maintenance and improvement of water quality,
- Intregrated and comprehensive land use planning,
- Recycling or disposal of solid and liquid waste,
- Identification of areas with flooding hazard,
- Assessment of soil resources for environmental impact statements,
- Reclamation of mined land,
- Identification of wetland,
- Suitability of soils for cultivation,
- Location of structures and roads

The standards (policy) and procedures to meet the objectives of the NCSS are reviewed regularly and revised as needed in consultation with the cooperators (Federal, State, and local), general policy guidelines are developed by the SCS, BLM, and other cooperators to meet program objectives and goals. Current policy, principles, standards and procedures are contain in:

- Soil taxonomy (1976)
- Soil survey manual (1951)
- National soils handbook

The National Soils Handbook provides working policy and specific procedure for planning, managing, and making soil surveys of the NCSC Policy and procedure are issued as National Soils Handbook Notices in loose-leaf form and are organized in six major subject areas. Subject areas and their respective NSH section numbers are:

- General
- Soil survey operations management
- Soil classification and mapping
- Application of soil survey information
- Information and display systems

The Bureau, with the revision of Soil Manual 7100 will design the Manual to interface and later be incorporated with the National Soil Handbook. This will keep the Manual up-to-date and be in step with the cooperating agencies in the NCSS.

The Bureau's goal for completion of the once over soil and vegetation inventories appears to be 1990 and 1992 respectively. After 1992 we can expect funding for the maintenance and upgrading of the soil and vegetation inventories to level off at a considerable lower figure than now being experienced by the Bureau.

We hear the term "high cost" for inventories, but when one puts these costs in terms of length of time of usefulness, than cost figures are considerably less. For instance, the soil inventory is useful for about 30 to 40 years at a cost of about 30 to 40 cents per acre. When this is amortized over this span of years, the cost per acre per year is about 1 cent on a National average. In the future, the cost of an update of the original soil inventory is much less because of useful data on hand. The Soil Conservation Service has updated many old soil surveys at a much less cost than the original soil survey. The justification was based on advances in technology.

The update of the vegeation data will probably be accomplished through monitoring and advances in technology. One could expect the costs of vegetation updates to be considerable less than the original inventory, using the principle of amortizing of the vegetation inventories over a period of usefulness (10 to 15 years) than the costs are about 3 to 5 cents per acre per year on a National average.

I thank you for this opportunity to participate in this workshop. Keep those letters and cards coming.

Hydrology, Water Resources, and Watershed Management in BLM

Collis Lovely - Hydrologist - WO (222)

A state of uncertainty exists within the Bureau of Land Management (BLM) as far as activities and programs related to hydrology, water resources, and watershed management are concerned.

The reorganization of the Washington Office (WO) and the Denver Service Center has resulted in confusion over the duties of the various staffs, the duplication of effort in many areas, and some activities not being covered at all. Field office program leaders and personnel working under the 4340, Soil, Water, and Air Management Subactivity have no counterpart in the WO. Field offices do not know what program area under the WO organizational structure is responsible for program policy, direction, budgeting, etc., for the programs they are administering.

The WO needs to resolve who is responsible for what, give appropriate direction to the affected staffs, then notify all WO Divisions, DSC, and all field offices. Enclosed is a tentative list of all the components and activities related to hydrology, water resources, and watershed management ongoing within the Bureau which must be made a clearly assigned responsibility of someone within the WO.

WO 220, 211, and 520 are trying to get these various responsibilities clearly assigned. Please review the attached list of water related activities and send any additions or comments to WO 222 and 211 so we do not overlook anything.

HYDROLOGY, WATER RESOURCES, WATERSHED MANAGEMENT, AND RELATED ACTIVITIES WITHIN THE BLM

1. Dam Safety Program
   - Coordination with Engineering

2. Floodplain Management
   - Compliance with E.O. 11988
   - Coordination with WO (240) on Wetlands
   - Floodplain Mapping, Studies, Investigations
   - 215 Funds - Emergency Flood Damage Repair Work

3. Hydrology (Surface and Groundwater: Water Quality, Climate)
   - Inventory for Land Use planning Purposes
   - Data Collection and Monitoring
   - Hydrologic Analysis and Interpretation
   - Instream Flow Investigations
   - Well Site Investigations
   - Data Storage and Retrival Systems

4. Research and Studies
   - Review, Approve, and Monitor Bureau Funded Hydrology Research
   - Saval Ranch Hydrology Studies
   - Rainfall Simulation Project
   - Salinity Research

5. Safe Drinking Water Act
   - Compliance Requirements
   - Coordination with Engineering

6. Water Quality (except data collection, analysis)
   - Compliance with Clean Water Act
   - 208 Water Quality Mnagement Coordination
   - 404 Permit System Coordination
   - Hazardous Waste Disposal Regulations

7. Water Rights
   - Water Laws and Opinions
   - Assertion and Protection of BLM Water Rights
   - Private Use and Rights on Public Lands
   - Water Use Permit System
   - Water Uses and Needs Inventory
     Quantification Methods
     Data Storage and Retrieval

8. Watershed Management
   - Watershed Management Activity Planning
   - Watershed Restoration and Maintenance
   - Watershed Condition and Trend Analysis
   - Runoff, Erosion, and Sedimentation Control
   - Watershed Protection

(This paper was presented by Milton Schloss, Senior Hydrologist, Water Resources Policy Staff, BLM Washington Office, to the Rocky Mountain Soil-Water-Air Workshop at Jackson Hole, Wyoming, February 2, 1981.)

I am here today representing the Water Resources Policy Staff and will be presenting papers prepared by Ron Kuhlman, Bernice Bigelow, and myself. As you know, Ron is involved with the 4340 budget, which includes funding many of the soil, water, and air activities in the Bureau. Bernice has been assisting him in this effort, so if you have any budget questions concerning your program, please contact her or Ron. Furthermore, Bernice has been given the assignment to rewrite Manual Section 7221 - Floodplain Management, which was originally scheduled for completion by the end of FY 1980, but because of higher priority work, little progress has been made to date. The new target date now is the end of FY 1981.

As for myself, I have been involved in writing the water rights manual - Section 7250, and I am happy to report that the final draft is now being typed and that copies of this draft will be sent to all State Hydrologists by the end of February for review and comment. Hopefully, there won't be too many changes. I am also responsible for preparing the water use inventory manual - Section 7211, which incidentally will be called the "Water Source Inventory" to more accurately describe the inventory data characteristics. As in Bernice's case, I have also been busy with other more urgent assignments, resulting in the fact that very little headway has been made in 7211.

Some of the other people in 211 are Dave Green and Royal Hall. Dave comes to us from EPA on a 2-year assignment to assist us in the interpretation of 208 regulations and hazardous waste implications for the BLM. He has just completed drafting an interagency agreement with EPA for BLM access to STORET, an automated storage and retrieval system of water quality data for both surface and ground water. Royal is an old time BLM veteran and, I am sure, most of you know him. He is the counterpart of Dave Green, in that Royal has been assigned to EPA Region 8 for two years to advise them regarding Bureau activities on the public lands.

Another hydrologist supported by 4340 is Collis Lovely. He is in the Washington Office of the Rangeland Management Division and came to 220 from the Arizona State Office this past July.

In this connection, I should like to mention that 4340 has established 18 new permanent full-time hydrologist positions in FY 1981. They have been allotted to the State Offices, and one each to the Instream Flow Group in Fort Collins, the RET Team also in Fort Collins, the Denver Service Center to work with Ronnie Clark, and the Phoenix Training School Staff.

For your information on 4340 funding for FY 1981, let us look at this chart. (Slide 1 - see below).

1981 ALLOCATIONS OF 4340 FUNDING

(in $1000's)

	CO	MT	WY
PAWP	1768	1096	1638
AWP	1306 (26.1%)	965 (11.2%)	1243 (24.1%)
52	736.2	518.08	510
53	212.1	297.85	542
54	66.8	21.3	90
SUPPORT	235.78	123.57	Prorate
OTHER (earth sci-paleo)	55.1	4.2	101

(%) - percent reduction from PAWP.

As you can see, the original submissions (PAWP) from the State Offices were trimmed in an unequal fashion. The factors considered in making these adjustiments are as follows:

(1) Quantity and quality of backup you provided describing planned accomplishments. (The more specific descriptions you gave, the better the chances of retaining your original estimates.)

(2) The percent of support cost you estimated compared to your total 4340 amount. (The higher the percentage and the less the documentation on the use of such funds, the greater the likelihood of increased cuts.)

(3) Your past record of program management. (Did you lose money because of slowness in your procurement process? Did you lose positions and/or funds to other programs? Did you accomplish the job you said you would?)

(4) Potential for "support" from other activities, e.g., 4322, 4110, etc.

(5) Your use of past p.f.t. staff specialists provided by 4340. (Are they still in 4340 or has the State reassigned them to "higher priority" programs?

(6) Your involvement in special projects, e.g., ongoing or imminent water rights adjudications.

I should now like to give you the Bureauwide outlook for 4340. (Slide 2 - see below).

BUREAUWIDE OUTLOOK FOR 4340

FY 1980	$18.4 Million		
FY 1981	22.1 "		
FY 1982	24.3* "		
FY 1983	A- 24.3 "	B-25.5	C-31.3

*Does not include:

Dam Safety	$2.6 Million
PRIA	2.0 "
D2AK	.1 "

Please note that the amount estimated for FY 1982 does not include funding for three other activities, i.e., dam safety, PRIA, and D2AK. It is anticipated that these programs will be supported by funding sources other than 4340. Also note that funding level B for 1983 is for the purpose of maintaining the '82 program plus anticipated additional programs, i.e., hazardous wastes, community watersheds, and air resource studies.

In the coming years, which programs will the Bureau continue to emphasize and which will be phased out? Well, be assured that water rights will continue to be a high priority item in order to meet State adjudication deadlines. Soils, on the other hand, because more than 50 percent of the surveys have been completed, will see a gradual decline in funding The air resource program will continue to be part of 4340, with support increasing from $700k in FY 1981 to substantially more in the following years. Earth sciences will remain in 4340 for the foreseeable future at about the present level, i.e., $400k - $500k. If further funds are needed, they should be sought from 4100. Threatened and endangered species has been removed from 4340 as of FY 1982. Hereafter, funding will come from Wildlife (240). Finally, dam safety is a relatively new program and should be more fully underway in FY 1982. Funds will be allocated to the States over and above the 4340 totals shown in this chart.

I should now like to offer some guidelines in connection with your PAWP. First of all, identify all cost and support needs to accomplish SWA goals in your State. Secondly, identify opportunities for operating efficiencies that might be achievable in your State. And, lastly, I cannot overemphasize the need for program justification. Be specific. Insofar as Colorado is concerned, increased attention should be given to site location studies for hazardous waste storage, 208 plans, and groundwater investigations and basin studies; decreased attention should be given to soil surveys. Montana should direct its efforts toward completion of 208 planning and the implementation of existing 208 plans, development of air resource studies (particularly acid rain investigations), and protection of critical community watersheds. You may play down your water rights and soil survey programs. Wyoming, on the other hand, should stress water rights and associated water use inventories, maintenance of water control structures, 208 planning and implementation of 208 plans, air resource studies, completion of soil surveys, inventory of paleontology resources associated with coal activity planning, and the continuation of the geologic atlas initiated in FY 1980.

In conclusion, let me say that our office (WO-211) will keep you apprised of any policy or program changes brought about by the new administration. What I have told you here today represents our latest information and guidance from BLM management. As soon as we receive any positive direction that may affect any of your programs, we shall advise you immediately.

Thank you.

Interagency Resources Evaluation Techniques Program

James S. Hagihara

BLM, Research Management Coordinator

Introduction

The RET Program is an interagency research and development program to promote coordination and cooperation between Bureau of Land Management, Fish and Wildlife Service, Forest Service, Geological Survey, and Soil Conservation Service in development of renewable resource inventory, evaluation, assessment, and planning activities. The principal objectives of this Interagency Agreement is to provide guidelines to minimize duplication and overlapping efforts and encourage overall data collection, data sharing, appraisal efficiency, program compatibility, and expedite technology transfer. The RET Program is headquartered at the Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado.

Background

The RET Program was initiated in 1976 by the Five-Agency Agreement that included BLM, F&WS, FS, GS, and SCS. The Council of State Planning Agencies, who represents the 50 states, joined the Five-Agency Agreement in November 1979. The authority and formulation for the Five-Agency Agreement was the result of four major Congressional acts that mandated the Secretaries of Agriculture and Interior to coordinate and cooperate in (1) preparing and maintaining continuous resource inventories, (2) avoid duplication in resource inventories and planning, (3) determine the changes in status and condition, both current and potential, of the resource base, (4) determine resource interactions and management alternatives, and (5) submit periodic assessments or appraisals on the status of our renewable natural resources. These are only a small portion of the actions that were mandated in the follwing Legislated acts.

1. Forest and Rangeland Renewable Resources Planning Act of 1974 (P.L. 93-378).
2. National Forest Management Act of 1976 (P.L. 94-588).
3. Federal Land Policy and Management Act of 1976 (P.L. 94-597).
4. Soil and Water Resources Conservation Act of 1977 (P.L. 95-192).

Major Problem Assignments

Five major problems that were determined to be common among the five agencies were identified and assigned to be completed by the RET Program. These problems are expected to be completed by December 1981. The assigned problems are:

1. Develop a national interagency hierarchial land classification system.
2. Define kinds of information required for national and regional resource assessments.
3. Develop a compatible national multiresource inventory procedure.
4. Evaluate and develop improved analytical processes for renewable resources data bases.
5. Improve and develop the data base management system for storage, retrieval, and display of resource data.

Status and Progress of Study Assignments

A. National Land Classification

A draft of the proposed Land Classification was completed in May 1980 and distributed for review to federal and state agencies, universities, and private groups for review. The Land Classification is a hierarchial component classification composed of vegetation, soil, landform, and water.

The vegetation component is based on ecological potential or climax and existing vegetation.

The soil component is the same as "Soil Taxonomy" and will be used without change as it has been approved and applied nationally and internationally.

The water component is being developed by an interagency technical group. It will address water as a habitat for life. A framework for the water component has been drafted thus far and will be completed by December 1981.

The landform component is also being developed by an interagency technical group. The landform component will address the morphometric and genetic characteristics of the landscape. A draft of the Landform Classification is being completed through a cooperative aid study with Colorado State University.

A National Land Classification manuscript is scheduled for publication by December 1981. This publication will include the four components and a description of each.

B. Information Needs Analysis

A Forest Service Information Needs Analysis (INA) is expected to be completed by April 1981. This will include identification of data elements, information items, and definition of standards. Several state-of-the-art papers related to analytical processes and techniques for timber, range, and wildlife are being completed. The Forest Service INA is very similar to the BLM DRD effort.

C. National Inventory Techniques

This study includes the evaluation of inventory methods currently being used by the land management agencies to develop a resource inventory method that will be compatible to the five-agencies. Problems being researched are measurement techniques, sampling designs, and mapping.

D. Remote Sensing

The goal for remote sensing is to (1) recommend alternative methods for stratifying land cover into homogeneous units by application of remote sensing techniques and (2) to have on line a digital image analysis system that is state-of-the-art. The digital analysis system will address sample points, map polygons, and include spectral classification, temporal image registration, change detection, solar and atmospheric corrections.

E. Data Management

The objective is to improve or provide a proto-type design of an interactive data maintenance system for accessing functional resource data files across agencies.

Future Plans

Plans are being developed for implementation,testing and transfer of the products to the five-agencies. Most of the products developed by the RET Program will require considerable field testing and training upon their uses and application.

PRESENTATIONS MADE ON

TUESDAY, FEBRUARY 3, 1981

Jack Kelly
Chief of Resources
Rawlins District

Management Perspective
on
Accomplishments and Shortcomings
of
The BLM Soil Program

Introduction

The Rawlins District has really been scrambling the past couple of years to keep up with all the demands of the various programs, and I am sure we are not an exception. Bureau-wide, the demands associated with priorities like livestock grazing EISs, new coal leasing initiatives, wilderness review, new land use planning requirements and others, have in many cases exceeded our capability.

The new Federal Coal Management Program essentially provides for leasing the most environmentally acceptable coal areas, considering a number of special criteria and other multiple use factors. Our rangeland mangement program is focused on allocating the vegetation resource in a manner which considers both consumptive and nonconsumptive uses while maintaining or enhancing productivity. The wilderness program has progressed from the inventory phase to the study phase which now will require input from all other programs, as the study phase is a multiple use phase of the program. All of these demands have a rippling effect and have substantially increased the support necessary for programs like soil, air and water. Inventory and analysis of these basic resources are imperative for all these new program initiatives in the Bureau.

In particular, the soils program has been hit especially hard with the need to provide support. This has resulted in some real accomplishments in the soils program as well as some problems.

In trying to respond to the request to present some thoughts on the accomplishments and shortcomings of BLM's soil program, my first reaction was that they are fairly obvious. I started by trying to develop somewhat of a balanced list, but as it turned out, it did not balance all that well. Regardless of whom I talked with, it was much easier to identify problems or shortcomings than accomplishments.

I do not think that's a surprise or all that negative or disappointing. In most cases, our accomplishments stem from knowing and discussing the problems. I think that might be right where BLM's soil program is today -- right at the beginning of some real accomplishments.

Characterization of the Program

Viewing some of the things we've been doing in the program in recent years, it is evident that the program is essentially a new one. Unfortunately, the need for soils data and analysis is not so new and has been with BLM from the beginning.

As recent as the late 60's and early 70's, it could best be characterized as a very infant program, one without a data base or sufficient staffing. Also, as one without up-to-date policy and guidance.

From that infant program it has begun to develop, and out of dire need and some foresight, we have launched in recent years into a massive soil survey effort. Most public lands will be surveyed by the late 80's. As necessary as this has been, it hasn't been without high costs in terms of lack of capability for other aspects of the program.

As we complete the surveys and have the necessary data available, our challenge is to make the best possible use of that data. Our emphasis must change to using the data in our rangeland management, coal, wilderness, oil and gas, and other programs.

Accomplishments and Shortcomings

As I mentioned earlier, it isn't easy to see a balance between the accomplishments and shortcomings of the program. Nor is that necessary.

To avoid the labelling problems, I think it is best to just discuss them together as program highlights or concerns.

1. Lack of Sufficient Soil Staffing and Base Data

These, of course, are the most obvious concerns. They are directly related and have a very similar affect; i.e., it results in a void for important input to our multiple use management efforts.

The data is often times not available or at least not at the appropriate level of detail. And sometimes, if the data is available, the professional staffing to make good use of it is not.

2. Lack of Program Balance

Another concern that more or less represents a dilema, considering the one we just discussed, is that the soil program is out of balance. That is, our efforts are so heavily committed to soil survey that we cannot accomplish the soil management aspects of the program.

This problem will not be resolved in the near future, but that should not become an overriding excuse for not working for a better program balance.

3. Quality Control

Quality control on soil surveys is another major concern, especially where contract efforts are involved. The tremendous acreages that have been planned for survey, without sufficient time to do the job, has been the number one cause of the quality control problem.

Another major contributing factor has been the lack of sufficient time and staffing for close contract supervision.

4. Meeting Land Use Planning and Environmental Assessment Schedules

The soil survey program has not been able to keep pace with other resource program demands. The most obvious being the land use planning and environmental assessment schedules associated with the coal, rangeland management, and wilderness programs.

The most serious effect resulting from this has been that the Bureau's decisions and actions have had to proceed on schedule without the benefit of soils data and analysis. This is particularly frustrating when the soil survey has been underway but is not "done" quite in time to be fully utilized.

5. Soil Data for the Sake of the Soil Program

We need to get away from the idea of collecting soil data for the sake of the soil program. There must be a very conscious effort in BLM to emphasize the interdisciplinary aspects of the program.

The soils people should take the lead on addressing the interdisciplinary aspects and demonstrate how the data and analysis can be used to the benefit of the other programs. They have to get away from the attitude of "here it is - use it."

This approach should be emphasized not only in the soils program but in the other disciplines as well.

Summary

One of our most significant accomplishments has to be the Bureau's commitment to the soil survey program. We have made very good progress in recent years, not only in surveying acreages not previously surveyed, but also in upgrading the quality of our surveys.

Our staffing is improving and we are now beginning to make good use of the survey data in our management programs. We can readily see this in the rangeland management program and some of our energy programs like coal and oil and gas.

The real challenge is to continue and even speed up this progress towards "completing" the soil surveys and at the same time emphasize the transition to effective use of the data.

Drilling Mud Study in Oregon Basin

John Kwiatkowski
District Manager
Worland District

A longstanding problem for oil companies has been the drying and reclamation of reserve pits. These large pits are used to hold water and drilling mud during drilling operations. When drilling is completed, the water must be removed through hauling or evaporation before the pit can be closed. This can involve a wait of several years and is a constant safety hazard to small children, livestock, and wildlife. When the water has been removed, the drilling mud starts to dry and can be buried. Drilling mud is a highly viscous mixture of bentonite clay, salt, and water.

In 1979, Dale Weaver, Inc., approached John Murray, Cody Resource Area geologist (BLM), about possible ways to accelerate the reserve pit closing time. After investigating several possible practices, it was decided to attempt to farm the mud into the soil's surface and then revegetate the area. Based upon work done by Dr. Raymond Miller at Utah State University on irrigation of drilling mud, BLM decided to attempt a similar process under dryland conditions.

District soil scientist Jim Whitmore and Murray began looking for an acceptable soil type and investigated the properties of various types of drilling muds. Once a site was selected and a design made, plans were sent to the Wyoming Department of Environmental Quality for approval, since drilling mud had been tentatively identified as a toxic waste.

In September 1979, the BLM, in cooperation with Dale Weaver, Inc., and DEQ, laid out a dryland test plot in Oregon Basin near Cody. The area is about 550 feet square and contains approximately 7.5 acres.

The area chosen is a sandy range site with the Worland soil series. This soil is a fine sandy loam about 40 inches deep over weathered sandstone. Native vegetation was predominantly big sagebrush, Indian rice grass, and threadleaf sedge. The range condition was fair and the site is representative of large areas in the Big Horn Basin. Soils and mud were tested for various salts, pH, and present heavy metal concentrations. The representative plants were tissue tested for the same constituent salts and metals.

Water based drilling mud was spread in strips across the plot in 6-inch, 4-inch, 2-inch and no-mud to act as a control. The mud was incorporated into the soil up to 1 foot deep and allowed to stand over winter. It is anticipated that the winter precipitation will leach the salts downward in the soil profile. Most indigenous native plants are salt tolerant to varying degrees, but all are sensitive to salts during germination. The last applications of mud are being applied early in the spring of 1980 due to weather halting the operation in 1979. Native species of grass and shrubs will be seeded late in the fall of 1980 vertically across the mud strips to give a plot or checkerboard effect. Species seeded will be (1) western wheatgrass, thickspike wheatgrass, and big sagebrush; (2) western wheatgrass, needle and threadgrass, Indian rice grass, and sweet clover; (3) thickspike, needle and threadgrass, and Indian rice grass; and (4) prairie June grass, Indian rice grass, and gardiners saltbush.

By using this method, each depth of mud-treated soil, including the control, receives four combinations of seeding. The entire area is fenced to prevent entry of livestock and wildlife. The entire area will be mulched and fertilized when seeded. When germination occurs in the spring of 1981, it is anticipated that most of the salts will be leached from the soil surface. Salts in the soil affect plant growth in several ways that cause concern. These include raising the pH, reduction of plant available water, and actual toxicity. Once the seedling is established, minor amounts of salts are not usually harmful. Drilling mud was analyzed prior to application and annual soil and plant samples will be taken. This will allow the BLM and Dale Weaver to predict salt effects and minimize any adverse impacts encountered.

A sandy soil with high permeability was chosen since it is presently well leached but is droughty due to its low water holding capacity. Drilling mud is fine textured and has a high water holding capacity. When the two are mixed, this will increase the soil's ability to supply water to the plant, but application of mud must not be so thick as to reduce infiltration and increase runoff. This is the reason for the various application rates--to find the optimum application rate.

If this project works as anticipated, it may be a way to accelerate the rehabilitation of a well site and to increase vegetative production on damaged areas. If it is not successful, valuable information will be gained and other disposal methods for drilling mud can be investigated. With the large number of new wells being drilled, it is hoped that this method is successful and can be used routinely to rehabilitate well sites and increase vegetative cover in surrounding areas.

This trial mud farm is another way the oil and gas industry and the Federal Government are working to successfully solve environmental problems. For further information on the mud farming process, call the Bureau of Land Management at Worland, telephone 347-6151.

INTERIOR
LAND MANAGEMENT
1981 APR 13 AM 10 00
RECEIVED
CHEYENNE WYOMING

Mel Clausen
Canon City District

Management Perspective on Accomplishments and Short-comings of the BLM Hydrology Program

The Canon City Hydrology "Program" is utilized to provide the District Manager and Area Managers with the kind of data and technical advice that they need to accomplish the various missions of the District. The primary function of the Hydrologist is to provide technical support for programs developed under other activities.

I. Accomplishments under the current Hydrology Program

A. Establishment of BLM water rights.

This involves determining the type of water source, the specific location of the water, the condition or quality of the water and the reliability over the course of a year as well as year to year. Some spinoff benefits to the district are derived from this inventory process. Our records are cleaned up and corrections are made in project files to show what is currently existing on the ground. We have also revised our job documentation records to reflect more realistically what is on the ground and its condition and requirements for maintenance needs. The inventory will be a tremendous help in the forthcoming review and revision of Public Water Reserves. Our MTP's are corrected so we can readily identify potential projects disturbance if an application for Right-of-Way overlaps the water source.

Once we have inventoried a water source we are making application to the courts for the water rights to assure we are on record as a user of water. We are also meeting the State Engineers requirements for registration of wells and reservoirs on those inventoried and where records are corrected.

Another benefit of this recent inventory and recording effort of water sources is the computerized storage and retrieval system now utilized. We can now very easily retrieve any data we desire as far as: type, location, condition, reliability, maintenance needs, and legal status as far as application and state decree. The system allows for very easy revision or updating if new projects or improvements occur or better information becomes available.

We are also preparing an atlas on 7½' maps showing location for ease in locating projects and water sources for any future planning.

B. Providing input into Planning and Environmental Assessments.

We are now getting much better data on the inventory overlays for URA's and potentials on overlays for MFP's and RMP's. This is a real asset and generally helps a decision maker to feel much more comfortable about decisions. Activity plans such as AMP's, HMP's or FMP's are also improved by the addition of more specific data on water resources.

We have participated in the 208 water quality planning process to ensure that the objectives and requirements of the 208 plan are compatible with BLM management objectives.

One result of the Upper Arkansas 208 plan is an interagency study and planning effort on Badger Creek, a notorious flood and sediment producing tributary of the Arkansas. BLM, Forest Service, SCS, Colo. Division of Wildlife, the State Land Board and EPA are involved.

Our environmental assessments and EIS's are greatly improved where we utilize our Hydrologists. We can be somewhat selective in using them to be sure they are not swamped and thus hold up projects - i.e. fencelines and cattleguards in dry country need little Hydrologic analysis, however, a cyanide leaching project to retrieve gold near a seasonal or intermittent stream could be essential to an adequate analysis.

The Hydrologist has been very helpful in technical review of other agency Environmental assessments or EIS's.

C. Technical Advice and Service to Other Activities in the District. We are utilizing our Hydrologist for well site investigations, well pump tests, reservoir design for runoff volume and rate of runoff, water catchment design and location and identification of flood plains. Water quality testing is done at the request of the Resource Areas or other specialists.

They are also providing a public service at the office to answer questions about climate, water rights, ground water, streamflow, or water quality in various watersheds. During the rafting season we answer 5-10 inquiries a week concerning the flow of the Arkansas.

We are now complying with State laws by obtaining drilling permits for water wells and we are protecting BLM water interests by monitoring water right applications by others outside BLM.

D. Conduct of Special Studies as Needed.

Some examples of special studies conducted or to be conducted in Canon City are: Hydrologic studies in San Luis Valley as specified in the Range Management EIS.; the Badger Creek cooperative investigation of the enitre watershed; the energy minerals resource inventory in the Raton Basin Coal area.

E. Conduct unit area inventories in support of any of the plans or projects above.

II. Some Shortcomings

A. Lack of a fully dependable program. Water quality monitoring effort is variable from year to year depending upon other work priorities. This is especially true as pending court cases take precedence over support needs for some other critical program.

B. Service to other activities or projects is still not working at an efficient level. Many projects are planned, funded and implemented with little or no input from a Hydrologist or even use of the specific info he might have available.

One example of this is the reservoirs we have constructed for livestock or wildlife water supply. Many of these are not being properly registered with State Water Engineers because we do not get the Hydrologist involved at an early enough point or that we still have so few Hydrologists, their time is too fully committed to searching records and reviewing water applications to determine the impact on potential BLM needs.

Another example is reservoirs are being constructed without spillway design and reservoir capacity criteria. Again Hydrologists are too fully committed to provide this much needed service of working directly with Engineers to assure the criteria used in reservoir design fits the specific location as far as land form, area drained, precipitation, 50-year flood, 100-year flood and expected run off.

Still another example is the recent Forest Management plans being developed are in need of considerable precipitation data throughout the plan area. Such detailed information from a precipitation network is not available due to the apparent lack of priority.

C. Hydrologic expertise in BLM is not being fully utilized in cooperative projects with other Federal or State agencies.

One good example of this is the closed basin project in the San Luis Valley. BLM has been essentially left out of the allocation of water for mitigation of the project because we did not have sufficient data to show that any water would be lost or area dried up due to the project. Even the studies we are now doing may not provide the baseline information we need to determine if the impact is being fully mitigated.

D. Lack of good communication between Hydrologists and other Activity Specialists or Area Managers. Just as with so many specialists which have come down in recent years, we often believe we know enough about the subject that we don't need to consult the specialist. We don't want one more thing to hold us up on a job or project, but then later we find out we are so involved it is tough at best to get worthwhile assistance from the Hydrologist.

III. Summary

In summary, we have come a long ways, but we also have a ways to go. Water as a basic resource is especially critical on BLM managed land here in the West. We in BLM have always recognized this and have become quite expert in developing springs, reservoirs, catchments and wells and piping water to dry areas. However, we have now arrived at a new level in management where we must realize that every acre foot of good quality water on public land,-whether it be rain from the sky, springs from the earth or locked up water in an underground aquifer, - is critically important to any plan we or other agencies develop, because it is so critical we must improve our communications with our Hydrologic Specialists and utilize their talents to the fullest extent.

Note: You might conclude by reminding the hydrologists and soils people that they have their responsibility to communicate also.

RANGELAND HYDROLOGY AND WATERSHED MANAGEMENT IN THE BUREAU

Collis Lovely - Hydrologist - WO (222)

Although the old Watershed Division no longer exists, Watershed Management, as defined below, is a viable and important program in the Bureau:

> "The use, regulation, and treatment of water and land resources of a watershed to accomplish stated objectives." (Soil Conservation Society of America, "Resource Conservation Glossary," 1976).
>
> "It is the management of the natural resources of a drainage basin primarily for the production and protection of water supplies and water-based resources, including the control of erosion and floods, and the protection of esthetic values associated with water." (Society of American Foresters, "Forest Terminology," 1944).

The soil and hydrology programs, presently located in the Division of Rangeland Management, form the basis of the Bureau's Watershed Management Program. Although soil and hydrology are primarily support functions in the Bureau they also act as the proponents for the principles and objectives of sound watershed management through the Bureau.

The following outline explains the scope of Watershed Management within the Bureau, it is a program with specific objectives, which under certain circumstanes, may require the development and implementation of one or more of the types of Watershed Activity Plans listed.

Outline for the Bureau
Soils and Hydrology Watershed Program

Inventory - Inventory basic resources and characteractics of Public Lands and put into a summary report by Resource Area.

Land Use Planning - Analyze and interpret inventory data and input to the Bureau Planning System, EIS's, and other agency's Planning Activities.

Watershed Activity Planning - Develop Watershed Management Activity Plans based on needs identified in the inventory and recognized by management thru the planning process.

Support - Support all Bureau Programs and activities in meeting their management objectives within the context of sound resource management and in compliance with all applicable laws and regulations relating to the Soil and Water Resource.

Implementation - Implement approved watershed activity plans.

Monitoring - Monitor the implementation of all management decisions that may significantly effect the Soil and/or Water Resource.

Update - Update inventories and analyze monitoring results and recycle of this information thru the planning and decisionmaking process.

Training - Train Soil and Water specialists as well as other BLM employees so that the above is properly carried out.

The following list contains examples of the possible types of Watershed Activity Plans that might be necessary in order to fully achieve desired watershed management objectives:

TYPES OF WATERSHED ACTIVITY PLANS

Special Management Plans

- Municipal Watershed Management Plans
- Critical Ground Water Basin Management Plans
- Floodplain Management Plans
- Water Quality Management Plans
- Water Yield Improvement Plans

Hydrometeorologic Data Collection Plans

- Monitoring Plans
    - AMP Implementation
    - Timber Management Plan Implementation
    - 208 Implementation
- Baseline Data Collection Plans
- Research or Special Study Plans

Watershed Rehabilitation Plans

- Runoff and Erosion Control Project Plans
- Water Quality Control Project
- Flood Control Project
- Salinity Control Project
- Desertification Control Project

Regardless of the location of soil and hydrology, within the Headquarters Office, the Watershed Management Program as defined within this memo, is and will continue to be an important and viable part of the Bureau's multiple use management of the public lands and their resources.

(This paper was presented by Milton Schloss, Senior Hydrologist, Water Resources Policy Staff, BLM Washington Office, to the Rocky Mountain Soil-Water-Air Workshop at Jackson Hole, Wyoming, February 3, 1981.)

Proposed BLM Water Rights Policy

The handout that has been distributed sets forth the water rights policy proposed for BLM's Manual Section 7250. It also describes new procedures for processing water use applications. However, I shall confine my talk to proposed water rights policy.

Insofar as BLM policy is concerned, the fundamental concept that underlies Federal water rights is based on the legal opinion of the Solicitor of the Department of the Interior. On June 25, 1979, he specifically stated that "... since the Federal Government has never granted away its right to make use of unappropriated water on Federal lands ... the United States has retained its power to vest in itself water rights in unappropriated waters, and it may exercise such power independent of substantive State law." In reference to the states, the Solicitor suggested that Federal agencies "... follow State law in acquiring Federal water rights to the greatest practicable extent" and this recommendation is duly noted in the 7250 draft.

Also included in the initial 7250 draft is the doctrine of Federal reserved and nonreserved water rights, which is likewise based on the Solicitor's Opinion of June 25, 1979. However, the Supplement to the Solicitor's Opinion, dated January 16, 1981, which was passed out with the draft BLM Manual Section 7250, now refutes the doctrine of nonreserved water rights. Please turn to page 3 of the Supplement, the middle of the page, where it says:

> "Except where Congress has reserved land or water for particular Federal purposes, Federal agencies should, as a matter of policy, acquire water rights in accordance with the substantive and procedural provisions of state law."

Now turn to page 5, bottom of the page, where Mr. Martz, the Acting Solicitor, says:

> "... FLPMA authorizes a wide range of land management activities that require the use of water, i.e., livestock grazing, habitat and food for fish, wildlife, and domestic animals, timber production, recreation and mining to name a few. However, FLPMA does not authorize or otherwise mandate the Department to appropriate or otherwise utilize water outside state recognized beneficial use concepts for the broad general purposes outlined as management objectives in the Act."

The Acting Solicitor, on the last page (page 6), concludes that:

> "Reading FLPMA as a whole and paying special attention to Section 701(g), I conclude that FLPMA does authorize appropriation of water for land management uses but does not give an independent statutory basis for claims for water uses inconsistent in any way with the substantive requirements of state law. The same analysis and conclusion is equally applicable to the Taylor Grazing Act. To the extent the Opinion M-36914 of June 25, 1979, is consistent with these conclusions it is withdrawn."

Thus, according to this opinion, the concept of Federal appropriative water rights has been significantly eliminated.

A question that we have been asked on several occasions is whether BLM should invest Federal funds in the development or construction of water sources if a State appropriative water right could not be obtained in the name of the United States. This applies, in particular, to instream flow uses for wildlife habitats and wild and scenic rivers not recognized as beneficial by some States. BLM policy in this connection states specifically that there should be no such expenditure where State law prohibits the specific use intended or cannot protect the water from other uses. Please turn to page 3 of the handout entitled, "BLM Water Rights: Policy and Procedures," about three quarters of the way down, you will see a paragraph with the heading, "Federal Expenditures." It states very clearly that:

> "Before the Bureau allocates funds for the maintenance, development, or construction of any water-related facility involving nonreserved waters for which a State appropriative water right is required, the Bureau shall determine whether it can obtain the State water right, either solely in the name of the United States or as a coholder with a private water user. If this appears to be a reasonable assumption, then the action may proceed. If this does not appear to be a reasonable assumption, then the appropriate program office should be notified that the Bureau will not be able to maintain, develop, or construct the proposed facility."

Another question that has come up several times is whether BLM can charge the permittee for the amount of water he/she uses. The answer is that the Bureau has no legal basis for selling water. There is only one exception, and that is the water from converted oil and gas wells. The authority is the Oil and Gas Well Conversion Act of June 16, 1934, which provides for "the sale or other disposition of such water." On page 3 of the draft policy statements handout, top of the page, the sale of water is discussed in detail. It says that:

> "The Bureau cannot charge a fee for the use of water originating on or under the public lands irrespective of whether the water in question is reserved, unreserved, or unappropriated, or if the

> applicant is a holder of a State appropriative water right. The Congress, through the Desert Land Act and its predecessor acts, severed the water from the land and authorized the appropriation and use of unappropriated water on the public domain by the States and private parties without charge by the United States. FLPMA does not change this provision of law. There are provisions in FLPMA such as Section 504(b) that authorize and direct the Secretary to charge fair market value for the use of the land that is needed for a right-of-way to get to the water source on the public lands, but these provisions do not authorize BLM to also charge an additional fee for the use of the water. There is one specific exception to this policy and that is water can be sold under the authority of the Oil and Gas Well Conversion Act of June 16, 1934, 30 U.S.C. 229a, from abandoned oil and gas wells capable of producing water "of such quality and quantity as to be valuable and usable at a reasonable cost." This authority applies only to water reservations from abandoned oil and gas wells. No other authority has been found that provides a specific legal basis for selling water."

The next logical question is whether BLM can assert a reserved water right for the use of water extracted from wells purchased from an oil or gas permittee or lessee after October 21, 1976. The answer to this question is found in a memorandum to the Regional Solicitors, dated January 26, 1981. The response starts at the bottom of page 3 as follows:

> "... No. 30 U.S.C. 229a (Act of June 16, 1934) does nothing more than authorize the Secretary of the Interior to purchase the casing of the well. It no longer independently authorizes or directs the Secretary of the Interior to withdraw or reserve the land on which the well is situated. After enactment of FLPMA, BLM has nothing more than an appropriative right to the groundwater extracted from wells purchased after October 21, 1976, from oil or gas permittees or lessees for the uses specified in the 1934 Act. A reservation of these waters may be claimed after October 21, 1976, if the Bureau of Land Management requests and obtains approval from the Assistant Secretary to withdraw areas upon which these wells are located for public water resource use under the authority of Section 204(d)(1) of FLPMA - 43 U.S.C. 1714. Reserved water rights pursuant to reservations created on these areas prior to October 21, 1976, are still valid."

The apparent contradiction implies that the Bureau should obtain a State appropriative water right whenever this will provide the protection for beneficial uses of the Bureau. In those States where this will not be possible because of nonrecognition of beneficial use, then it may be possible to assert a reserved water right if the Bureau receives the approval of the Assistant Secretary for Land and Water Resources.

As you know, water rights may be acquired by the Bureau with the purchase, donation, exchange, or condemnation of parcels of land owned by non-Federal parties. It is also possible to purchase water rights alone. In any case, after title to the land and/or the water rights has been transferred to the United States, the Bureau shall notify the State and, in accordance with State procedures, file the appropriate documents to effect transfer of the State appropriative water right into the name of the United States.

In those States that recognize riparian water rights as well as those rights gained by prior appropriation, BLM State offices shall protect any Federal riparian rights that may exist to waters on or adjacent to public lands by claiming these water rights in accordance with State legislative and/or administrative procedures.

Water rights for mineral development have not been specifically reserved for this purpose by any Act of Congress. Therefore, water used for mining is regarded as nonreserved Federal waters and, as such, requires a State appropriative water right. The mining applicant for mineral development on the public lands has to file for a State appropriative water right, with the United States as coholder of the right. If the water is to be impounded, stored, or transported via ditch or pipeline to the mine, the applicant must apply to the Bureau for a right-of-way and, at the same time, fill out a Notification of Proposed Water Use in Conjunction with Application for Right-of-Way Grant. In the case where the mineral rights are Federal and the surface ownership is private, obtaining the State water right is solely the responsibility of the applicant.

Water facilities, such as wells and reservoirs, needed in connection with livestock grazing on the public lands may be constructed with a Section 4 Permit authorized by the Taylor Grazing Act. However, Federal grazing permittees are required to comply with the law of the State in which the grazing district or unreserved lands of the public domain used for grazing are located. Where necessary, the permittee or lessee shall acquire State appropriative water rights for public grazing in the name of, or for the benefit of, or for the use on, the public lands of the United States and with the United States as coholder of the right. Such water rights shall revert to the United States if or when the grazing permit or lease expires or is extinguished.

In the case of the Bureau claiming instream flow water rights, there may be certain legal ramifications that provide alternative courses of actions, depending on the State involved. In the West, the protection of instream flow-values has generally been viewed as in conflict with the basic requirements of the Appropriation Doctrine, namely that (1) an actual diversion of water is required and (2) the water is being applied to statutorily defined beneficial uses. Recently, the States of Colorado, Idaho, Montana, Oregon, and Washington have eliminated the requirement that a water right must have a diversion. They now allow either appropriation or reservation of flow for instream uses, and, in these States, the Bureau should file for a State appropriative water right. In those States where instream flow uses are not recognized as meeting the beneficial use requirement for a State appropriation, the Bureau may

(1) assert a Federal claim to water if Congress has by specific statute authorized the Secretary to reserve the water without regard to State law, (2) protect instream values in water sources on the public lands by stipulating conditions of access to the surface estate, i.e., rights-of-way, etc., or (3) notify the appropriate program office that the Bureau will be unable to implement the proposed project because it was unable to secure a State water right. It is important to point out that the Bureau should not rely on asserting and obtaining instream flow reserved water rights on the basis of historic or natural stream flows. Instream flow rights may be claimed only to the extent necessary to conserve the resource values directed by Congress or by the execution of the Reservation Document. In other words, these water rights are authorized only for that quantity of water which is required to protect the various scenic, natural, wildlife, and public enjoyment resource values for which the land was specifically reserved.

Closely related to instream flow water rights is the Wild and Scenic Rivers Act of 1976, which asserts Federal reserved water rights to any stream or portion of a stream which has been designated by Congress as a national wild, and scenic, or recreational river. The Act reserves to the United States that amount of unappropriated waters flowing through the Federal lands necessary to preserve and protect in free-flowing condition the particular aesthetic, recreational, scientific, biotic, or historic features ("values") which were responsible for the stream's designation as a National Wild and Scenic River. It must be emphasized that the river designation does not automatically reserve the entire unappropriated flow of the river. Only the volume of the flow necessary to fulfill the purpose of the reservation should be specified in the reserved water right.

Water rights in wilderness areas are closely linked to instream flows and wild and scenic rivers. In accordance with the Solicitor's Opinion of June 25, 1979, Federal reserved water rights may be claimed for water required to maintain minimum flows and lake levels and for ecological maintenance in statutorily designated wilderness areas. I should like to point out that Wilderness Study Areas (WSA) are regulated by the Bureau's "Interim Management Policy and Guidelines for Lands Under Wilderness Review" of December 12, 1979. For example, Section 14 allows BLM hydrologists to install temporary snow gages, water quantity and quality measurement instruments, and hydrometeorologic devices for the purpose of compiling a water resources inventory for each WSA. For those areas under wilderness reviews, survey and investigation activities for new water resource projects may be permitted so long as they are non-impairing as defined by Section 2 of the Guidelines. Construction of wells, reservoirs, and other water facilities will be deferred until the final recommendation is acted upon by Congress.

Finally, geothermal waters on public lands are not to be categorized as Federal reserved waters or are they subject to appropriation pursuant to State water laws. They are a form of geothermal resource subject to the Geothermal Steam Act of 1970. Applicants who wish to develop such resources require a Federal geothermal lease and a right-of-way grant for the tranmission of steam, hot water, or electricity across the public lands.

Conclusion

The topics discussed here represent some of the policy highlights contained in the handout. As mentioned before, these policies will be incorporated into Manual Section 7250. All State office hydrologists will receive copies of the 7250 draft manual for review. We shall look forward to your comments and, hopefully, an official version of Manual Section 7250 will be ready in early Spring.

JAN 20 1981

Milt Schloss
WO 211

DRAFT

BLM Water Rights: Policy and Procedures

INTRODUCTION

One of the more critical issues facing BLM hydrologists today is the need for a clear definition of Bureau policy concerning reserved and nonreserved water rights to the water resources on Federal lands and whether such rights are exempt from State regulation. This paper sets forth the proposed policies contained in the draft Manual Section 7250 and also describes the new procedures involved in processing applications for water use.

DRAFT POLICIES ON WATER RIGHTS

A. Water Rights Assertion. Water rights will be asserted only for those quantities of water actually needed to implement Bureau programs.

B. Compliance with State Law. The Bureau will comply with applicable State law to appropriate water necessary to manage the nonreserved public lands for the purposes directed by Congress, notwithstanding that the Solicitor has held that the Federal Government retains the right to appropriate and use water appurtenant to the public lands not theretofore appropriated.

1. Private individuals and entities have the right to appropriate unappropriated water on the public lands pursuant to State law for use on privately owned lands. Access to water sources on the public lands must be acquired through permission from BLM. Right-of-Way grants for the transportation of such water so appropriated on the public lands for use by private individuals off the public lands shall be granted only after a finding by the Bureau that such grants are consistent with multiple use management and shall be appropriately conditioned to protect Federal resources and Bureau programs.

2. The Bureau shall obtain a State appropriative water right to abandoned but functional artificially developed water sources or man-made water collection structures on the public lands, if the use of such water is needed for Bureau programs or projects.

3. The Bureau must apply to the State for water rights needed for Bureau programs or projects on all water sources, unless the land and/or water (1) is reserved by Act of Congress or Executive Action, or (2) Congress specifically provides that the Bureau is to acquire water rights without regard to State law.

4. The Bureau should acquire water rights needed for Bureau programs or projects to water sources located on acquired lands pursuant to State law. Reserved water rights to water from springs and waterholes located on acquired lands cannot be asserted under PWR No. 107.

5. The use of nonreserved water appurtenant to public lands by private applicants (permittees, lessees, etc.) for use on public lands requires compliance with State law. The Bureau shall require that it be

E. Sale of Water. The Bureau cannot charge a fee for the use of water originating on or under the public lands irrespective of whether the water in question is reserved, unreserved, or unappropriated, or if the applicant is a holder of a State appropriative water right. The Congress, through the Desert Land Act and its predecessor acts, severed the water from the land and authorized the appropriation and use of unappropriated water on the public domain by the States and private parties without charge by the United States. FLPMA does not change this provision of law. There are provisions in FLPMA such as section 504(b) that authorize and direct the Secretary to charge fair market value for the use of the land that is needed for a right-of-way to get to the water source on the public lands, but these provisions do not authorize BLM to also charge an additional fee for the use of the water. There is one specific exception to this policy and that is water can be sold under the authority of the Oil and Gas Well Conversion Act of June 16, 1934, 30 U.S.C. 229a, from abandoned oil and gas wells capable of producing water "of such quality and quantity as to be valuable and usable at a reasonable cost." This authority applies only to water reservations from abandoned oil and gas wells. No other authority has been found that provides a specific legal basis for selling water.

F. Planning. Water resources will be considered and addressed throughout the preparation, amendment, or revision of resource management plans as provided by 43 CFR 1601. This will include an identification of water related issues as well as appropriate consideration in the management situation analysis of the need for water, and the physical and legal availability of water. Water will be treated as a resource to be managed with particular attention to its supportive functions. The availability of a State or Federal water right necessary to fulfill the purposes of a program or project will be determined prior to the preparation of an activity plan. Planning for future development shall not proceed until water requirements to meet the intended objectives are determined to be a realistic and a practical probability.

G. Federal Expenditure. Before the Bureau allocates funds for the maintenance, development, or construction of any water-related facility involving nonreserved waters for which a State appropriative water right is required, the Bureau shall determine whether it can obtain the State water right, either solely in the name of the United States or as a coholder with a private water user. If this appears to be a reasonable assumption, then the action may proceed. If this does not appear to be a reasonable assumption, then the appropriate program office should be notified that the Bureau will not be able to maintain, develop or construct the proposed facility.

H. Access. The BLM has authority under sections 302(b) and 501(a) of FLPMA to control and regulate access to the water sources by right-of-way (R/W) grants. This authority also permits the Bureau to require information from a R/W applicant, grazing permittee, etc., concerning proposed water use and shall appropriately condition its grants to protect land and water resource values on the public lands.

1. In conjunction with its existing permit and leasing system, the Bureau requires a R/W grant for projects involving the transportation of water, i.e., canals, ditches, flumes, pipes, pipelines, tunnels, or other facilities, as well as for the impoundment, storage, or distribution of water upon the public lands.

2. The Bureau shall also require that for all proposed water projects on the public lands, the applicant must file a "Notification of Proposed Water Use in Conjunction with Application for Right-of-Way Grant" (see Attachment 1). The R/W grant issued under this system shall allow the use of water originating on and under the public land and for transportation of water across the public lands but require that for unreserved water a State appropriative water right be obtained, if State law so requires, within a reasonable period of time, normally not to exceed one year from and after the issuance of the R/W grant. For water needed in the management of the public land resource programs, the name of the United States or the names of the permittee and the United States shall appear on the certificate. For water not needed in the management of the public land resource programs, the name of the United States need not appear on the certificate. The grant shall also contain a specific provision requiring that any State water right, obtained for use in conjunction with the grant, shall be relinquished on expiration, revocation, abandonment, etc., of the grant. The R/W grant thus prohibits the grantee from claiming, seeking, or acquiring permanent and exclusive right to the use of the water needed in the management of public land resources and from transferring the State appropriation to a third party.

3. If the R/W applicant will not consent to having the water right granted to the U.S. as a coholder or the State will not grant the water right with the Bureau as a coapplicant and/or coholder of the State appropriative water right, then the R/W grant may be denied by the Bureau since issuance of rights-of-way under section 302(b) and 501(a) of FLPMA is discretionary with the Secretary. Furthermore, the Bureau can subject the R/W grant to whatever terms and conditions under section 504(c) of FLPMA as it deems necessary to adequately protect and manage the public lands, including protection of water resources, provided that such terms and conditions are not arbitrary and capricious.

4. All water use projects requiring a right-of-way shall be recorded on the master title plat (MTP) when the authorizing document, i.e., right-of-way grant, is recorded.

I. Inventory. A comprehensive, up-to-date inventory of all Bureau water sources, uses, and needs shall be compiled and maintained in order to identify the physical and legal availability of water on public lands. This activity is prerequisite and basic to the development and implementation of water-dependent Bureau management plans and programs.

J. State Communication. The Bureau, as a matter of comity, shall inform the State of proposed water resource uses on the public lands by non-Bureau users. This may be accomplished by transmittal of a copy of the Notification of Proposed Water Use in Conjunction with Application for Right-of-Way Grant. It is not necessary for the permittee to notify the State.

PROCEDURES FOR PROCESSING WATER USE APPLICATIONS

The following is a brief outline of filing procedures which will allow the public to use water from a reserved or nonreserved public source on the public land. If this water is to be impounded, stored, transported, or distributed on or across the public lands, then pursuant to Title V of FLPMA, a right-of-way (R/W) grant is required of the applicant. In conjunction with the R/W, a Notification of Proposed Water Use is filed concurrently with the R/W application. See Attachment 1 for a sample Notification form.

Notification of Proposed Water Use. All proposed water projects on the public lands require that a completed Notification form be submitted by the applicant, together with the R/W application, to the Authorized Officer having jurisdiction over the proposed project site. The District hydrologist receives the Notification form and makes the determination as to the availability of the water source for development and/or utilization. He/she further establishes whether the water source has been reserved by the Federal Government, or if the applicant should file for a State appropriative water right. No additional application forms are required if the water source under consideration will be used and had been reserved as (1) a stock driveway waterhole; (2) a mineral or medicinal spring; (3) a converted oil or gas well or a related water source well used for drilling purposes; or (4) a public water reserve. On the other hand, if the applicant is considering a nonreserved water source, such as a well, spring, or stream currently in use or formally used for mining, grazing, irrigation, or municipal water supply, or proposing the construction of a new well to be used for any of these purposes, then a State appropriative water right should be obtained, with BLM identified as holder or coholder.

Right-of-Way Grant. The applicant must file for a Right-of-Way Grant if he proposes to construct a water reservoir, canal, ditch, flume, lateral, pipe, pipeline, tunnel, or other facility or system Grant if he proposes to construct a water reservoir, canal, ditch, for the impoundment, storage, transportation, or distribution of water on the public lands. The applicant obtains the R/W application form stamped with a predesignated serial number from the appropriate District Office. When completed and returned, both the R/W application and the Notification of Proposed Water Use are identified with the same serial number. This policy of serialization provides a cross-reference system between the water projects indicated on the master title plat (MTP), R/W Grants, Notifications of Proposed Water Use, and their corresponding case files. Before the R/W application can be approved, a land report must first be prepared by the District realty specialist. This report includes an environmental assessment or environmental impact statement, depending on the significance of the water project under consideration, and other documentation. At the same time, the District hydrologist performs a water impact analysis and determines how the projected water use will affect the flow and quality of the adjacent water sources. The last step in the R/W approval process has the State Office appraiser preparing a land appraisal of the land to be used for the R/W. If the appraisal cannot be immediately prepared, this action may be deferred until after the R/W grant has been approved. Once the grant has been issued by the authorized officier, i.e., either the State Director or District Manager, the water project is plotted on the MTP and thereon identified with the aforementioned serial number.

It should be pointed out that a R/W grant may be issued for the actual construction, operation, maintenance, or termination of a water project or for access to the project site. A R/W temporary use permit (TUP), however, may be issued for the prior gathering of information needed by the District Office in its assessment of the proposal and for determining whether or not to issue the R/W grant. This TUP may also be issued for the temporary use public land after issuance of the grant if the use is to facilitate the purpose for which the grant was issued.

Records Serial Number. In addition to the responsibilities cited above, the District hydrologist will ensure the proper identification, i.e., serial number, of all water projects on the MTP, as well as their corresponding case files, water use Notification forms, and R/W applications, at the time when the R/W grant is recorded. This serial number, which appeared after the R/W application form was filed, must now be appended with a "WF", if the water project involves Federal reserved water, or a "WS", if the project requires a State appropriative water right. Additional digits may be added for the purpose of water use coding.

CONCLUSION

The policies and regulations discussed in this paper, which will be incorporated into BLM Manual Section 7250, are only proposed and, therefore, should be regarded as tentative. Once the draft BLM Manual Section 7250 has been reviewed and approved by BLM's management and by the Office of the Solicitor, it will become the official BLM position on Water Rights.

Notification of Proposed Water Use in Conjunction with Application for Right-of-Way Grant

R/W Application No. ______ W ______

Date of Filing: ______________

1. Name of applicant(s) ______________________________
   Post Office address ______________________________
   County of ______________ State of ______________ Zip ______

2. If applicant is a corporation: (a) Date and place of incorporation
   ____

   (b) Number of licensed stock ______________ (c) Allotment No. ______
   (d) Authorized agent name ______________ (e) Address ______________
   ____
   ____
   ____

3. Quantity of water requested (g.p.d.) (c.f.s.) (ac. ft. yr.)
   (Circle one of above)

4. Season of use ______________ to ______________

5. Location of water requested:

   (a) Source name ______________ Stream/Well/Spring/Waterhole
   (Circle one of above)
   which is a tributary of ______________________________
   which is located in ______ 1/4 ______ 1/4 Sec. ______
   Township ______ Range ______ County ______
   total volume of flow of this source (g.p.d.) (c.f.s.) (ac. ft. yr.)
   (Circle one of above)
   Source of data ______________________________

   (b) Diversion is located in ______ 1/4 ______ 1/4, Sec. ______
   Township ______ Range ______ County ______

   (c) Use(s) occur(s) in ______ 1/4 ______ 1/4, Sec. ______
   Township ______ Range ______ County ______

   Indicate the location of source, diversion, and development(s) on the filing map accompanying the R/W application.

6. Proposed uses of water: ____________________
and extent of need, including, but not limited to, the following: people served, acres irrigated, livestock watered, products produced, recreational visitor days per year, or other ____________________
____
____
____________________.

7. If developments or impoundments are proposed, complete the following:

(a) Conduit (pipe) or ditch:

Diameter/Depth ________; Length ______; Slope ______ft. per 1000 ft.
Capacity at outlet ________ (c.f.s.) (g.p.d.) ________
(Circle one of above)

Elevation at inlet ______(ft., m.s.l.), or outlet ______(ft., m.s.l.)

(b) Storage tank(s) or trough(s):

Width/Diameter ______, Length ________, Depth ________;
Capacity ________gal.; Shape ____________
Width/Diameter ______; Length ________, Depth ________;
Capacity ________gal.; Shape ____________

(c) Other (state type and include dimensions) ____________________
____

(d) Estimated development costs:

	Materials	Labor	Total
Conduit	$______	$______	$______
Tank(s) or Trough(s) . . .	$______	$______	$______
Other ____________ . . .	$______	$______	$______
		Total Cost . . .	$______

(e) Proposed date construction is to begin ____________________.

(f) Proposed date construction is to be completed ____________________.

(g) Proposed date of full use of water applied for ____________________.

8. If the water is to be impounded, stored, transported, or distributed on or across the public land, a right-of-way permit is required by the applicant. Title V of FLPMA provides the sole means of granting the needed right-of-way.

(a) If you already possess such a document, fill in the serial number of the authorization. Serial No. ____________________.

(b) If you have yet to secure such a document, a right-of-way application should be filed in accordance with 43 CFR 2800: Rights-of-Way, Principles and Procedures.

9. Will there be any foreseeable reason for changing the quantity of water or type of uses requested? __________. If yes, when will the change in use or quantity take place and by what amount? __________
____.

10. Is the water to be used supplementally with other waters? __________.
If yes, describe the other waters, including permit numbers or water rights numbers if applicable ____________________
____.

11. Has the water being requested been subject to litigation or a protest of record? __________. If yes, specify Date: __________
Number: __________, Administering agency: ____________________.

12. Do you have an existing State water rights certificate, application, or claim for the water being applied for on file with the State of __________? If yes, specify Date(s) __________ Number(s) __________ Type(s) __________ (attach separate sheet, if needed).

THE FOREGOING STATEMENTS ARE TRUE TO THE BEST OF MY KNOWLEDGE AND BELIEF.

____
Applicant or Agent

Dated this ____________________ day of ______________, 19__

Stan Coloff
WO 202

AIR RESOURCE PROGRAMS

I. Air Resource Inventory and Monitoring

A. Compilation of Existing Air Quality Climate and Meteorology Data.

USE: Planning, EIS, EA, Lease, Rights-of-Way Actions, Forage Yield, Smoke Management

B. Acid Rain Monitoring

Purpose: 1. Determine significance of acid rain in the West and role of energy development
2. Support national atmospheric deposition program (NADP) to determine national trends

Status: Five stations operational: California (1), Colorado (1), Idaho (1), Oregon (2)

Five planned for FY 81-82: Wyoming (2), Utah (2) Montana (1), Arizona (1)

Consolidated sample analyses

C. Visibility Monitoring

Purpose: Determine visibility baseline in areas where energy development is planned and in the CDCA.

Status: Two stations under agreement with EPA in Utah (1) and California (1). One station in Colorado with Forest Service.

II. Technical Assistance-Training

A. Air Quality Modeling for Coal Lease Planning

Purpose: Develop, test, qualitative screening model to identify the air pollution potential of lands being considered for lease sale.

Status: Identify models

B. Air Quality Training Module

Purpose: Basic orientation to BLM air resources program

Status: May 81 completion

III. Participation in Air Resource Management Decisions of Other Federal Agencies and States

A. EPA Visibility Protection Regulations

B. State, EPA, FS, NPS, Coordination

- Visibility
- Increment Tracking
- Smoke Management
- Industrial Growth and Development

IV. Air Resources Research/Studies

A. Fugitive Emissions from Coal Strip Mines (Colorado)

B. Lichens as Natural Indicators of Sulfur Dioxide Concentration (Wyoming)

C. LANDSAT Remote Sensing to Detect Visibility Changes (DSC)

D. Acid Rain, Visibility as Air Quality Related Values

Stan Coloff
WO 202

AIR RESOURCE MANAGEMENT

User Demands (Identification of Issues)

Consumptive:
- Coal Fired Power Plants
- Syn-fuel Plants
- Smelters
- Strip Mining
- Prescribed Burn
- ORV Races

Nonconsumptive:
- Hunting
- Fishing
- Hiking
- Camping
- Grazing

Decision Factors (Planning Criteria)

1. Federal/State Laws, Standards, Regulations

2. Air Resource Related Factors
    - SIP
    - Area Classification
    - Available PSD Increment
    - AQRV's

3. Related State and Federal Goals and Policies
    - State Industrial Growth
    - Domestic Energy Development

4. Public Comment
    - Private Citizen
    - Industry
    - Professional Societies
    - Environmental Groups

Analysis (Management Situation Analysis)

1. Analytical Tools
    - AQ Models
    - Emission Factors
    - Standard and Reference Methods
    - Data Management and Retrieval Systems
    - Effects simulators

2. Air Resource Information
    - Atmospheric Conditions
    - Source Characteristics
    - Effects
    - Location

Stan Coloff
WO 202

AIR QUALITY

Legal Requirements

1. 1970 Clean Air Act

State Role (SIP)

National Ambient Air Quality Standards (NAAQS)

Primary - Health
Secondary - Public Welfare

2. 1977 Clean Air Act

Prevention of significant deterioration - PSD

- Area designation-Increments
  Class I, Class I, Class III
- Preconstruction Review - MEF
- Air quality related values (AQRV)
- Visibility
- Redesignation of areas

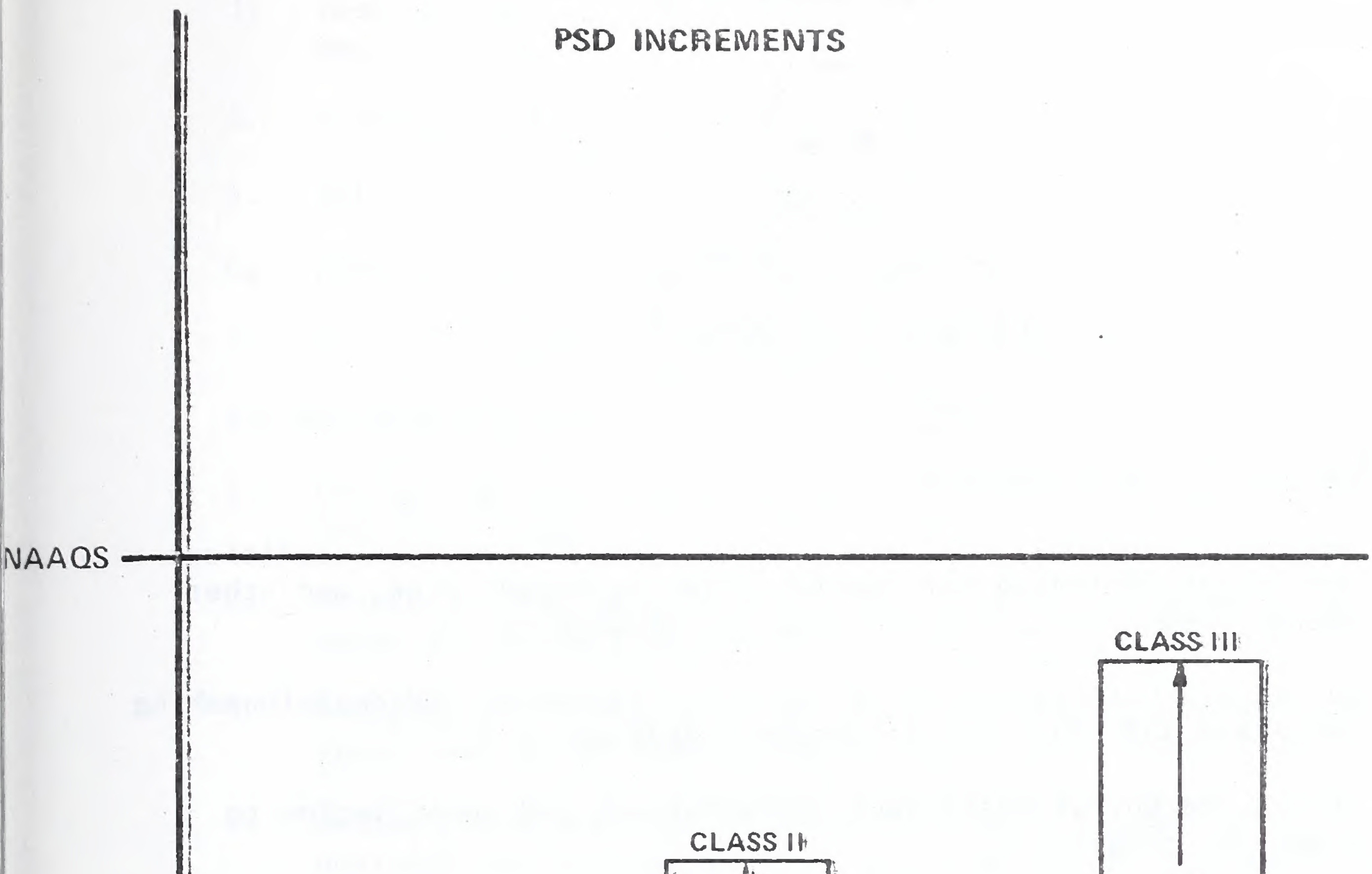
FLPMA Requirements

- Multiple Use - "Harmonious and coordinated management of the various resources without permanent impairment of the productivity of the land and the quality of the environment."

Sec. 201(a) Inventory and Identification
Sec. 202(c)(8) Land Use Planning
Sec. 204 (c)(2) Land Withdrawal
Sec. 302(b) & (c) Management use, occupancy, development
Sec. 503 Right-of-Way
Sec. 603 Wilderness

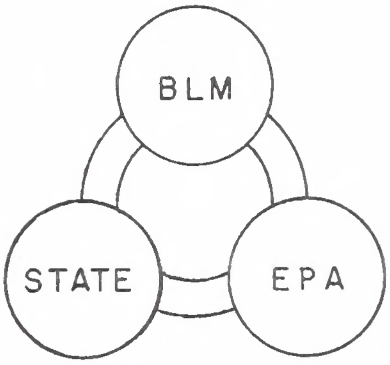
AIR RESOURCE

Definition: The air resource is defined as (1) the quality of the atmosphere as characterized by the ambient concentration of air pollutants, visibility, odors, sound, and other energy forms transmitted through the atmosphere, and (2) the climate and meteorology characteristics such as temperature, humidity, precipitation, solar radiation, wind speed, direction, and atmospheric stability.


PSD INCREMENTS

GEMINI Transparency Mounts
Keuffel & Esser Co., Morristown, N.J. 07960 Made in U.S.A.
VISUAL EDUCATION PRODUCTS
K+E

AIR RESOURCE MANAGEMENT:
A Shared Responsibility



Air Resource Program Elements

1. Monitor, inventory, evaluate, and analyze air resource conditions and trends including air quality climate, sound, wind, and other energy forms transmitted through the atmosphere.
2. Advocate consideration of air resource values in BLM decisionmaking processes and other permit review processes.
3. Provide technical assistance, information, and consultation to other BLM programs.
4. Participate in planning and decisionmaking process of other Federal and State agencies affecting air resource management.

Air Resource Program Activities

A. Manage the existing use and future consumption of the PSD increment with the State.

B. Provide technical air resource information for planning, environmental assessments, rights-of-way withdrawals, lease actions, and other land use decisions.

C. Cooperate with the State, other land management agencies, and Federal and local agencies to protect standards and review proposed rules, SIP's, and redesignation.

D. Develop and maintain a professional staff and technical expertise throughout the Bureau to carry out air resource management responsibilities.

Air Resource Management - Washington Office: Basic Responsibilities

1. Development of air resource policy and program goals and objectives.
2. Review new, proposed, and existing regulations, laws, and implementation plans affecting Bureau activities.

3. Develop budget, conduct planning, and develop strategies to implement programs.

4. Coordinate with other governmental agencies.

5. Establish training goals and standards.

6. Advocate air quality protection and control.

7. Provide overall program direction, coordination, and evaluation.

Air Resource Management - State, District Office: Basic Responsibilities

1. Conduct air quality, climate, and other air resource inventories and monitoring.

2. Assure SO programs and activities comply with Federal, State, and local air quality standards.

3. Coordinate SO program plans and activities with State air quality agency and other Federal agencies.

4. Review State implementation plan (SIP) and voice State Office position and recommendations on revisions and changes to SIP.

5. Evaluate consumption and existing use of air quality increments and determine influence on existing and future programs and activities.

6. Provide technical support and consultation to other SO and DO programs.

7. Incorporate air quality considerations into planning process.

8. Conduct air quality modeling, special air quality monitoring, and evaluations.

9. Recommend air quality control and protection methods and emission and ambient air quality levels for lease stipulations and other Bureau actions requiring protection of air quality and air quality related values.

10. Conduct air quality training programs.

VISIBILITY

Its Basis in the Clean Air Act
Regulatory Status
Implications to BLM and Future Direction

Tom Lukow
Bureau of Land Management
Wyoming State Office
Air Quality Specialist

I. The Clean Air Act amendments (1977) 47 U.S.C. 7491

- A. Part C - Prevention of Significant Deterioration
  - 1. Section 169A: Visibility Protection
    - a. Key to the existing visibility regulations
  - 2. Section 165: Preconstruction Requirements
    - a. Key to future visibility regulations
  - 3. Section 164: Area Redesignation
    - a. Visibility implicitly discussed in this section
- B. What is visibility?
  - 1. Nontechnical definition: The relative ease with which objects can be seen through the atmosphere under various conditions.
  - 2. There are two types of air pollution which the regulations must address:
    - a. Smoke, dust, and colored gas plumes or layered haze emitted from stacks
    - b. Widespread, regionally homogenous haze from a multitude of sources
  - 3. Kinds of visibility degradation
    - a. Reduction in visual range
    - b. Discoloration
    - c. Whitening of the horizon
    - d. Obscuration of some portion of the landscape

C. Section 169A: Visibility Protection

1. Requires reasonable progress towards "the prevention of any future, and the remedying of any existing, impairment of visibility in mandatory class I Federal areas which impairment results from manmade air pollution"

2. Mandatory class I Federal areas are composed of all international parks, all national wilderness areas and memorial parks (5,000 acres), and national parks (6,000 acres) 158 total

3. Requires DOI review of the 158 mandatory class I areas to identify those in which visibility is an important value (40 CFR Part 81, Nov. 30, 1979) 153 total

4. Requires EPA to promulgate regulations to assure reasonable progress towards the national visibility goal (40 CFR Part 51, Dec. 2, 1980)

5. Requires EPA to approve or disapprove the State Implementation Plan revisions

D. Section 165: Preconstruction Requirements

1. Subpart B of 165 states: "The Federal Land Manager and the Federal official charged with direct responsibility for management of any lands within a class I area has an affirmative responsibility to protect the air quality related values (including visibility) of any such lands within a class I area . . . ."

2. FLM's may recommend the denial of a PSD permit if an adverse impact on visibility will result, even if the class I PSD increments would be met (Section 165(d))

3. PSD applicants must analyze the visibility at the site of the proposed construction and any area potentially affected by the proposed construction (Section 165(e))

E. Section 164: Area Redesignation

1. "The FLM shall review all national monuments, primitive areas, and national preserves, and shall recommend any appropriate areas for redesignation as class I where air quality related values are important attributes of the area"

II. Present Regulatory Status

A. EPA promulgated the visibility regulations December 2, 1981 (40 CFR Part 51)

1. Phased approach

   a. Phase 1

      (1) Requires control of impairment that can be traced to a single existing stationary facility Best Available Retrofit Technology (BART)

      (2) Evaluate and control new sources to prevent future impairment

      (3) Requires States to adopt strategies such as review and possible control of other existing sources not meeting the more stringent source-size requirements for existing stationary sources

   b. Future phases will extend the visibility program by addressing more complex problems such as regional haze and urban plumes

2. The program

   a. 36 States involved

   b. Have 9 months in which to submit SIP revisions

   c. Requires close coordination between the State, the "affected" FLM, and the EPA

   d. States retain the primary responsibility for developing an effective visibility program

   e. The "affected" FLM has the responsibility of characterizing the visibility of the mandatory class I areas (including integral vistas)

   f. The State, in its initial SIP revision, will have to consider an integral vista only if the vista is identified at least 6 months prior to SIP submittal (NPS has already identified a preliminary list of integral vistas. Jan. 15, 1981)

   g. For new sources, integral vistas identified at least 12 months before submission of a complete permit application must be protected

        h. The requirement to protect integral vistas is part of the visibility protection program and is not part of the PSD program

        i. All integral vistas must be identified before December 31, 1985

    3. EPA's preliminary observations

        a. Have identified no existing sources which will need to install additional controls under the regulations

        b. Some large new sources will be required to analyze their potential impact on visibility in mandatory class I Federal areas

III. Important Regulatory Definitions

A. Integral vista: An important view from a point in the mandatory class I Federal area of a scenic landmark outside the boundary of the area.

B. Adverse impact on visibility: Visibility impairment which interferes with the management, protection, preservation, or enjoyment of the visitor's visual experience of the Federal class I area. This determination must be made on a case-by-case basis taking into account the geographic extent, intensity, duration, frequency and time of visibility impairments, and how these factors correlate with (1) times of visitor use of the Federal class I area, and (2) the frequency and timing of natural conditions that reduce visibility. This term does not include effects on integral vistas.

C. Federal Land Manager: The secretary of the department with authority over the Federal class I area.

D. Natural conditions: Includes naturally occurring phenomena that reduce visibility as measured in terms of visual range, contrast, or coloration.

E. Significant impairment: Visibility impairment which, in the judgment of the Administrator, interferes with the management, protection, preservation, or enjoyment of the visitor's visual experience of the mandatory class I Federal area.

This determination must be made on a case-by-case basis taking into account the geographic extent, intensity, duration, frequency and time of visibility impairments, and how these factors correlate with (1) times of visitor use of the Federal class I area, and (2) the frequency and timing of natural conditions that reduce visibility. This term does not include effects on integral vistas.

F. Visibility impairment: Any humanly perceptible change in visibility (visual range, contrast, coloration) from that which would have existed under natural conditions.

G. Visibility in any mandatory class I Federal area: Includes any integral vista associated with that area.

NPS PRELIMINARY LIST
Integral Vistas
January 15, 1981 CFR

I. Key Points

- A. 48 mandatory class I AQ areas
- B. 46 evaluated; 43 have integral vistas.
- C. Glacier still being studied
- D. 1 mandatory class I area not identified
- E. 177 in-out vistas
- F. 5 out-in vistas
- G. Air work group will be developing comments on the draft NPS integral vistas (see attached memo).

II. In-Out Integral Vistas

A. Colorado

1. Black Canyon of the Gunnison	4
2. Great Sand Dunes National Monument	2
3. Mesa Verde National Park	5
4. Rocky Mountain National Park	2

B. Wyoming

1. Grand Teton National Park	3
2. Yellowstone National Park	1

C. Montana

1. Glacier National Park - Evaluation not complete

III. Out-In Integral Vistas

A. Colorado

1. Great Sand Dunes National Monument	1

B. Wyoming

1. Grand Teton National Park	1

PRESENTATIONS MADE ON

WEDNESDAY, FEBRUARY 4, 1981

Contour Furrowing as a Range Management Practice[1]

Earl L. Neff and J. Ross Wight[2]

ABSTRACT

Contour furrowing has evolved during the past 50 years as a mechanical treatment to increase forage production and control runoff and erosion on semiarid rangelands in the United States. Furrows are most effective if constructed on fine- to medium-textured soils; if spaced 1 to 2 m apart; if they carefully follow the contour; and of sections are separated by adequate intrafurrow dams. Furrows are less effective, or even detrimental, if constructed on coarse-textured soils where there is little or no runoff under natural conditions; if spaced more than 2.5 m apart; if they do not follow the contour; or if furrow water storage capacity is lost by breaching and failure of intrafurrow dams. Successful contour furrowing requires careful attention to the details of surveying and flagging contour lines and to supervision and inspection during operation of the furrowing machines.

---

[1] Contribution from the USDA, SEA, AR, in cooperation with the Montana Agricultural Experiment Station and the Bureau of Land Management, USDI.

[2] Research Hydraulic Engineer and Supervisory Soil Scientist, USDA-SEA, Agricultural Research, P. O. Box 1109, Sidney, Montana 59270

Use of Models for Forecasting Range Forage Yields[1]

By

J. Ross Wight[2]

---

[1] Presented at the BLM Soil-Water-Air Workshop, February 2-6, 1981 at Jackson, Wyoming. To be submitted for inclusion in Proceedings of Soil-Water-Air Workshop.

[2] Range Scientist, Northwest Watershed Research Center, USDA-SEA-AR, Patti Plaza - Suite 116, 1175 South Orchard, Boise, Idaho 83705; in cooperation with Bureau of Land Management, USDI, and the Agricultural Experiment Station, University of Idaho, Moscow, Idaho 83843.

Use of Models for Forecasting Range Forage Yields

J. Ross Wight

Classically, range forage yield predictions have been made primarily by regression models. In their simplest form, these models are linear regression equations with forage yield as the dependent variable and annual or seasonal precipitation as the independent variable. To account for the effect of the distribution of precipitation during the growing season, multiple regression equations have also been developed, which use various combinations of monthly precipitation as the dependent variable. These regression models have been further improved by using beginning soil water content and/or climatic parameters, such as pan evaporation or independent variables. Regression models, however, are usually site specific and their application is limited to the site and conditions from which the data used to calculate the regression were obtained.

To extend the application of regression models to a wider range of sites and conditions, site factors, such as soil texture and soil depth, have been considered. The simplest and, perhaps, the most effective way to account for yield variations due to site characteristics is the use of the long-term average site yield as an independent variable (Wight 1981). Such a factor integrates the total effect of site factors, such as texture, slope, and species composition. The use of yield and precipitation indices as the dependent and independent variables, respectively, have provided an excellent means of extending the geographical applications of regression models (Sneva and Hyder 1962). The indices are simply the expression of the yield and precipitation variables as portions of the long-term median yields and precipitation, respectively.

In recent years, there have been increasing efforts to quantify the physical aspects of plant growth, particularly for cultivated crops. The result of these efforts has been the development of physical-based productivity models. Such models are more transferable among range sites, crops, and climates than are the regression models.

Wight and Hanks (1981) adapted a physical, crop model for use in rangeland ecosystems. Using beginning soil water content, daily precipitation, and estimates of potential evapotranspiration (calculated from solar radiation and daily mean temperature) as inputs, the model calculates daily soil water content, potential transpiration (T_p), and actual transpiration (T). Forage yields at peak standing crop are calculated from the relationship: $Y/Y_p = T/T_p$, where Y is actual yield and Y_p is the potential site yield. The model's output, T/T_p, provides an effective means of indexing the growing season's production. Note that when water is nonlimiting, $T/T_p = 1.0$. This index accounts for the amount of precipitation, its distribution, associated evaporative demand, and soil water content.

The physical-based model readily lends itself to forage yield forecasting through use of historical climatic data. One method of forecasting requires the soil water content at the beginning of the growing season and historical climatic data from a nearby weather station. The model can be run for as many years as there are climatic records. Each model run produces a yield index (T/T_p) based on actual soil water content, and the precipitation and potential evapotranspiration from a past year's climatic record. For example, to forecast 1981 forage yields, the soil water content at the beginning of the 1981 growing season would be used with each model run. If 50 years of climatic data were available, the model could be run 50 times, producing a population of 50 yields or yield indices. Experience to date has indicated that the yield indices are normally distributed. Thus, the mean and the variance of such a population can then be calculated and probability statements can be made as to the expected yield interval around the mean. For example, if the mean of the 50 model runs was 1000 pound forage/acre and the standard deviation was 300 pound forage/acre, we could state that there was a 67% probability that the 1981 forage yield for that particular site would be between 700 and 1300 pounds/acre.

The initial forecast made at the beginning of the growing season can be updated periodically within the same year (monthly or such intervals), by using the soil water content determined at the beginning of the growing season with the current year's climatic data up to the date of forecast and historical climatic data for the period of time between date of forecast and peak standing crop. The model would again be run 50 times and a new population of yields generated. Because beginning soil water and climatic data up to the date of forecast were the same for all 50 runs, the population of yields would be distributed closer around the mean than they were for the first forecast date. Thus, the yield forecast would have a relatively smaller interval. For example, the new mean might be 900 pound forage/acre with a standard deviation of only 200 resulting in a 67% probability interval of 700 to 1100 pounds/acre. With each forecast update, the forecasted yield interval would decrease.

Use of forage production models, particularly the physical-type, with historical climatic data provides a means of forecasting range forage production at various probability levels. Such forecasts can provide a basis for grazing management decisions.

Literature Cited

Sneva, F. A., and D. N. Hyder. 1962. Estimating herbage production on semiarid ranges in the intermountain region. J. Range Manage. 15: 88-93.

Wight, J. Ross, and E. Bruce Godfrey. 1981. Predicting yield response to nitrogen fertilization on northern Great Plains rangelands. XIV International Grassland Congress, June 15-24, 1981, Lexington, Kentucky. (In press).

Wight, J. Ross, and R. J. Hanks. 1981. Predicting range herbage production with a water-balance, climate model. J. Range Manage. (In press).

Howard Wertsbaugh, Canon City District

FIELD WATER RIGHTS INVENTORY
in
COLORADO

My purpose here today is not to explain how to conduct a proper water rights (sources) inventory, but to share with you some of the experiences - and mistakes - that we have encountered during the course of our inventories in Canon City.

It is my hope that those of you who are yet to begin your efforts can benefit from some of the things that we have learned.

In the early spring of 1979, we were doing our own thing in the Canon City District. Suddenly, we were rudely awakened by the news that we had been served notice to participate in water adjudications in two different Water Divisions in Colorado.

To say that we were unprepared is an understatement. We had just finished with the Royal Gorge MFP, and were gearing up for the Grazing Environmental Statement. Our plans for field work were limited to a low level water quality inventory. The deadline for submitting applications to Water Division 2 was just six months away, and we were already committed to other, high proirity work. Needless to say, we weren't too excited about the whole thing. However, since we had no choice, we cheerfully agreed to do our best.

But before I continue, let's take a quick look at the Canon City District. The District administers about 1.2 million acres of Public Lands on the eastern slope of Colorado. Three major drainage basins are involved, the South Platte, The Arkansas, and the Rio Grande. As you can see, much of our land is in small, scattered tracts. This often presents problems with access. The topography, particularly in the Arkansas Drainage is steep and rugged, and physical access is difficult. Public Lands in the Rio Grande drainage, however, are more accessible and easier to get around on. Now back to our story.

As I said before, our field plans consisted of nothing more than a small water quality inventory. Therefore, we were forced to do some real fast recruiting - and believe me, the pickings were slim. However, fortune smiled, and we were able to find a crew who though untrained, seemed to have the characteristics that we were looking for.

Speaking of characteristics, don't overlook personality and communication skills when you select your field people. These are very important. One of our people was afraid to talk to ranchers. If he came across a locked gate while searching for a water source, that was the end of the search, as far as he was concerned. On the other hand, we had another guy who liked people, and quickly picked up the local jargon. This man could talk the rancher's language. He not only got through the locked gates, he had the ranchers showing us water sources that we didn't know existed! Anyhow, there we were, we had a crew, we had a job to do, but where to begin? Believe me, we had only the foggiest notion of how many, what kind, and above all, where, our water sources were.

We began by searching the office for existing records. We went through project files, old (1972) water rights applications, the step 2 URA's, the grazing files, and the JDR printouts. We listed all of the springs, reservoirs and wells that we could find record of. Then we sorted this data by topographic map, and put together what we called our "black book". Our little black book contained the names and addresses of all the water sources that were rumored to exist. Sorted by topographic map, we listed name, type, project number and legal description.

Now, this may seem like a very logical approach, but it had it's pitfalls. For example, the 1972 water rights applications contained filings for conditional rights on wells that had never been drilled. We spent a lot of time looking for wells that never existed! The URA step 2 data was less than useful. It contained errors inherited from other records and added only confusion. In our case, I think we dug up too much information. There were duplications, conflicts, and confusion created by going to so many sources of data. For us, at least, we would have been better off if we had just used the project files as a starting point. That may not be the case in other Districts.

Okay, armed with out "black book". maps, cameras, and little else, we went to the field. Unfortunately, we had little time (or insight) to train the crews, so we pretty much "learned as we went".

Needless to say, we made our share of mistakes. Due to lack of proper instruction, some of our people thought that a watering trough was the same as a spring. So we ended up with reports describing a "dry spring", simply because the tank was not connected with the water source, which was upstream and around the bend!

The fellow who was afraid of ranchers liked to "high grade". He would inventory any source that could be reached from a county road, even if another person had inventoried it the week before. Of course, this points out deficiencies in supervision, and a lack of communication among our very own crew.

Practically everyone came down the the body count syndrome. "How many did you knock off today?" "Shoot, is that all? We got ten!". This resulted in incomplete and confusing reports. This also meant that someone had to go back and reinventory correctly. We had forgotten that the objective was not just to find the water. The objective was to find the water, describe it, locate it properly, and document the whole thing!

Another mistake was lack of periodic office follow up. We generated a large amount of reports, maps, and photos. With this much data coming in, it is essential that you take the office time necessary to check, organize, and file your data as it comes in. We learned the hard way that the longer you put off the office work, the more difficult it is to interpret, correct, or clarify the field reports.

Enough about our foul-ups for now. Let's take a look at some of the problems and situations that were really out of our control.

First, we found the contents of our project files to be highly variable. Some contained only a JDR, and you know that a JDR does not provide very much information. Others contained a plethora of information. Not always accurate, but lots of it. The 1940 vintage records were the best. They had photos, survey notes, drawings, calculations, etc. Overall, though, over 60 percent of our records had incorrect legal descriptions, and this one thing caused us many a headache.

One common problem was that things on the ground often bore little resemblance to what was described in the files. This caused considerable head scratching on our part, until we accepted the fact that not only are the files sometimes a bit untruthful, but that time (and lack of maintenance) also takes its toll.

We found that springs, especially, come in all sizes, shapes, conditions, and methods of development. These facts caused us to greatly expand our space for "remarks" and "sketch" on our field forms. Also, some springs are very difficult to find, and I don't think that any crew should be embarassed if it takes two or three days to track one of these down. In our experience, the hard-to-find springs were usually well used by wildlife.

So far, I have mainly discussed the mistakes, the problems, and the realities of inventory that we encountered during our first field season. After spending the winter going through our data and making out water right applications, we realized that we had better get our act together.

We revised our field forms (for the third or fourth time) and ordered equipment so that each of our two crews would have the same tools to work with. The same cameras, the same tapes, abneys, compasses etc. This was to eliminate confusion in units of measurement and to help standardize our data collection.

Thanks to my colleague Bill Holub (District Hydrologic Technician), we were determined that we would not take to the field again with inadequately trained crews. In his words "don't take anything for granted". What he meant was, it is easy to assume that an individual understands the objectives of the work, and has the skills and the desire to carry it through.

In the spring of 1980 then, the first thing we did was to take our new crew to the field for some on-the-job training. We ran them through everything: reading maps, taking pictures, reading abneys, pacing techniques, and even opening and closing of gates (you'd be surprised at the number of young people that don't understand the consequences of not closing the gate behind you).

We tried to make sure that they understood why they were going to the field in the first place, and what we expected them to bring back. We stressed that they should observe and record any information that could aid in our evaluation of the water. In other words, don't just fill in the blanks on the field form, but look around, and record things that are relevant. For example, elk tracks around a spring is relevant data. Water dogs in a stockwater pond indicates reliable water. Landmarks will help the next guy find the spring. Describe the access route. Put it on a map, if its complicated. If you had to ask permission to cross private land, who did you talk to? And last, but not least, make a sketch of what you found.

We not only stressed those things during the training period, we continued to do so throughout the field season. We had to, because after awhile, the work gets to be monotonous, and it's human nature to let things slide a little. Picture yourself making detailed notes on the 200th stockwater pond of the season. This extra supervisory effort has really paid off for us. Most of the field reports from last summer are a joy to work with, when compared with the first year's result.

What are we doing with the data? Two years ago, the objective was merely to find where our waters were, and to decide if they should be filed upon. In the course of this effort, we discovered a real need to straighten out the errors, conflicts, and confusion that exist in our project files, JDR record, PWR records and master title plats.

Our first step, of course, was to organize our own data, and to put it in a format that would facilitate the correction of the other records (not to mention our water right filings). Naturally, in this day and age, this calls for using a data storage and retrieval system - and that's what we are doing. However, for the time being, we're doing it in sort of a small time way. We thought at first, we could put our stuff into QWICK QWERY, a Forest Service system that Mike Whittington in Montana is using. Unfortunately, we soon ran into some logistical and political problems. Our State Office people thought we should use REX, but they were still messing with a format. Since we had to get on with the program, we ended up inventing SHUCKS, a small town acronym for Small, Here, Useable, Controllable, and Kinda Sexy. Seriously, we needed to get a handle on our data so that we could manipulate it for our own immediate needs. So, we just put it on the District word processor. Not too fancy, but it gives us what we need for the time being. The sort capacity is limited, but we can extract what Justice needs to have for water filings; we can use it to correct JDR records, and we are sorting by legal description to reconcile the PWR determinations. An important spin-off, is that our range cons and wildlife people are using our printouts right now, for their AMP's and HMP's. They really like it, because all they have to do is to walk up to our cute little AMPTEX operator, say "aw shucks", and she produces a printout for them.

Eventually, of course, we will get on board with a real computer, but in the meantime, we have something that suits our needs.

To conclude, as I said before, my purpose was to share our experiences, not to tell anyone how to do it. I think the thing to remember, is that every Resource Area, District, and State, has different cirumstances to work under. However, we all have one thing in common-and that is to make sure that BLM has the water necessary to perform her missions.

(This Paper was presented by Milton Schloss, Senior Hydrologist, Water Resources Policy Staff, BLM Washington Office, to the Rocky Mountain Soil-Water-Air Workshop at Jackson Hole, Wyoming, February 4, 1981.)

FLOODPLAIN MANAGEMENT

1. FEMA RESEARCH

In November 1980, the Bureau was asked to provide a list of potential floodplain and wetlands research projects which could be directed or funded by the Federal Emergency Management Agency (FEMA), the parent agency of the Federal Insurance Administration which distributes flood insurance studies and maps and coordinates research on floodplain management and flood damage reduction. Due to the short turn-around time allowed for BLM's response, the State Office hydrologists did not receive memos requesting input; however, responses were coordinated between 211 (Water Resources Policy staff), Rangeland Management, Wildlife (which has responsibility for wetlands), Planning, and the Office of Coal Management (for coal program regulations unsuitability criteria) in the Washington Office. A copy of the Bureau response, which was signed December 15, is to be provided to each BLM State Office. If any hydrologist would like to add additional topics or expand on those already listed in the Bureau responses, send this information to Bernice (211) and they'll be included in a follow-up response to FEMA.

2. FLOODPLAIN MANAGEMENT MANUAL SECTION

Rewrite of Manual Section 7221 was originally scheduled to be completed by the end of last fiscal year; however, little progress has been made to date. New target date is the end of this fiscal year. Additions to the Manual Section will include a listing of hydrologic methods and qualifying conditions, such as geographic area(s) of applicability, drainage size limitations, etc. -- and what type of Bureau actions need to consider floodplains, including suggestions of when floodplains should be avoided (for example, when an action would have a direct impact on public safety, such as an overnight campground which might have greatest use coinciding with seasonal extreme storms). Although the Manual Section will still contain material on general floodplain management and water resources policy to satisfy an "audit" by the Water Resources Council (an effort they started last summer), the intent of the revision is to make it user-oriented for operating personnel.

3. WATER RESOURCES PUBLICATIONS

On January 2, Bernice Bigelow sent each State Office hydrologist a list of Corps of Engineers' water resources publications that may be of use to field office personnel. The publications are written in manual format, are easy to follow, and are free. Because the Corps' publication depot is in the Washington metropolitan area, a quantity order for all Bureau offices will be coordinated by and then distributed to field offices from the Washington Office. If anyone feels that there are publications and manuals by other agencies (Forest Service, the GS, SCS, etc.) that may be of benefit or use by other offices, drop off a note to either me or Bernice, and a quantity order will be submitted from our office.

On January 9, Bernice sent each state hydrologist a printout of the USGS flood-prone quads for your use -- in the past she's distributed a listing of Corps of Engineers' Flood Plain Information Studies and a list of flood insurance maps published by the Federal Insurance Administration. We're taking suggestions on schedules of updating this information, and whether you think this practice of distributing general reference material should be continued or accelerated.

4. COAL HYDROLOGY

Bernice has received complaints from the Office of Coal Management in the Washington Office -- it seems that BLM field office personnel are directly contacting USGS offices to have them compute 100-year floodplains for the Federal Coal Program Unsuitability Criterion Number 16, which states that unless "mining can be undertaken without substantial threat of loss to people or property, and to the natural and beneficial values of the floodplain on the lease tract and downstream," the mining of Federal coal is unsuitable. From what Bernice has been able to gather talking with a few of the State Office hydrologists, the BLM personnel working on the coal program are not communicating with the hydrologists to have the work developed by or reviewed by BLM water resources personnel -- and instead, most of the hydrologists are being by-passed. The GS is becoming irritable because they're supposed to act in a review capacity, rather than a data-generating function on the coal program. Also, apparently when BLM coal offices submit hydrologic data that was done by consultants (funded by the coal programs) to the GS for review, there is insufficient material to review (assumptions, coefficients and calculations are missing), which leads us to believe that the BLM hydrologists are also being by-passed in this capacity as well. (If insufficient data are available for an evaluation by a BLM hydrologist, it stands to reason that a GS review would be unproductive.) Bernice in my office is trying to "smooth the feathers" of the GS personnel (all the complaints from the GS field offices are being registered with one individual in their headquarters office), but in order to get this situation turned around, we need the assistance of all BLM hydrologists -- make your capabilities known to the folks in your office working on the Federal Coal Program. If you feel you are still being by-passed, even for review of their hydrologic analyses, let me know what the specific problems are, and my office will set up a memo with the Washington Office of the coal program to try and remedy the situation or to force the issue out into the open.

5. STORET

Dave Green, who is working in WO-211 on a 2-year loan from EPA, has written up an interagency agreement with EPA for BLM access to STORET for water quality data. This is a procurement item funded by the Washington Office -- we have allocated a total of $12,000, but we have received assurances from EPA that there will be no problems should our use exceed any costs over the $12,000. The current status of the agreement is that it's going through the surname and signature process. Once the agreement is signed, the Washington Office will be contacting each State (by telephone and then by written confirmation) to relay your State's access code. At that time, Dave will also let people know whom they can contact for training courses, user manuals, etc.

6. CONCLUSION

For more specific information regarding any of the subjects covered, contact Bernice Bigelow at (FTS) 343-5994. Thank You.

is signed, the Washington Office will be contacting each State (by telephone and then by written confirmation) to relay your State's access code. At that time, Dave will also let people know whom they can contact for training courses, user manuals, etc.

6. CONCLUSION

For more specific information regarding any of the subjects covered, contact Bernice Bigelow at (FTS) 343-5994. Thank You.

Hydrology and Watershed Inventories

Collis Lovely - Hydrologist - WO (222)

The Hydrology and Water Resource Inventory Program is designed to determine the hydrologic, water resources, and watershed characteristics of public lands. This inventory will determine the general supply of surface and ground water, its availability, quantity, quality, and distribution; it will include the inventory and analysis of the physical watershed characteristics, climatic and hydrologic characteristics, and existing conditions and uses of public lands. An integral part of the program is the interpretation of results in terms of the management opportunities (potentials and constraints) with respect to maintaining, protecting, or restoring the water resource, watershed conditions, floodplains, and other water resource values associated with public lands as well as for the other resource programs and management activities within the Bureau.

All public lands under our jurisdiction need a certain basic level of inventory. Our inventory manual contains four different levels of inventory depending on the management objectives and decisions to be made. Each level of inventory is a one-time assessment at that particular level of detail, however, as our intensity of management increases, more detailed levels of inventory would be required. Basic data gaps would be identified by the inventory and appropriate data network designs proposed and carried out through the activity planning process.

A Level III inventory would generally be appropriate for BPS inputs and conducted on a Resource Area Basis according to the BPS and EIS schedule. More detailed inventories would be conducted as the need arises, such as the detailed site specific inventory of water sources being conducted for water rights purposes.

Hydrologic and Water Resource Inventories

OBJECTIVE OF INVENTORY:

To improve land use planning and resource management decisions by: evaluating current resource conditions; establishing a base for measuring change; and predicting potentials and constraints for management based natural characteristics of public lands.

PURPOSE OF 7210

To provide guidance for conducting inventories needed to determine the hydrologic, water resources, and watershed characteristics of public lands in a: systematic, scientifically sound, and consistent procedure.

THE PROCEDURE:

I. Preinventory Planning (defines level of inventory needed).

  A. Define Management goals and objectives - Decisions to be made.

  B. Critical issues and areas.

  C. Time and people constraints.

  D. Data needs to meet A and B.

  E. Define data that can be obtained given constraints in C.

II. Literature Review - Existing Data Search.

III. Stratification of Inventory Area (P.U. Resource Area)

  A. By Drainage Basin

    1. Natural watersheds: River basin to small substitute watershed.

    2. Necessary to describe streamflow and water quality characteristics.

      WRC-USGS Hydro-Unit Map
      - Topographic Maps
      - Aerial Photos

  B. By Hydrologic Response

    1. Areas of land which are relatively homogenious in the way they respond hydrologically.

      Uniform watershed conditions
      Uniform precipitation-runoff characteristics
      Uniform on-site hydrologic characteristics.

    2. Land areas with similar potentials and constraints for multiple use management.

    3. Basis for sampling and extrapolation, interpretation, and prediction of impacts.

    4. Key criteria - climatic factors
       physiographic factors

IV. Field Sampling or Data Collection

  - Amount is based on detail or level of inventory.

V. Analysis and Interpretations

VI. Inventory Report

- Manual - Under final revision.

  Out in final - April-June.

- Need development of field handbook and training course to get program implemented.

INSTREAM FLOW SURVEYS IN WYOMING

Presented at the
BLM-Rocky Mountain Regional Soil-Water-Air Resource Meeting
by Michael D. Stone
Wyoming Game and Fish Department, Cheyenne
February 4, 1981

DEPARTMENT OF
BUREAU OF LAND MANAGEMENT
1981 FEB 23 AM 10: 06
RECEIVED
CHEYENNE, WYOMING

Wyoming is in a unique position of giving rise to nine sizable drainages. Most significant in terms of volume discharge are the Snake River Drainage, Green River Drainage, Clark's Fork-Yellowstone River Drainage, Big Horn River Drainage and the North Platte River Drainage. Stream mileage that can support substantial fish populations totals 16,200 miles. At first glance this mileage appears to represent an abundance of water. Much of this mileage (59%) crosses public lands. BLM lands account for 8% of the total stream mileage and 13% of the total mileage on public lands.

Stream fisheries in Wyoming are divided into 5 classes--class I represents the most important waters of national significance and class 5 represents poorer quality streams--often barely capable of supporting fisheries. Class I streams total 416 miles, of which 50 miles are on BLM land. BLM lands account for 70 miles of the 1200 miles of class 2 stream. Likewise 359 miles of class 3 streams are on BLM land. Total mileage for Class 3 streams is 6970 miles. These three classes represent the bulk of the better quality, more important streams in Wyoming.

To bring this large number of stream miles into perspective, conversion to an approximate stream surface area is useful. Rough calculations (based on 15 to 50' average stream width) put the total stream surface area in the range of 50 to 150 square miles--a figure much smaller than many western ranches. Compared with Wyoming's total area of 98,264 square miles, these streams make up only .05 to .15% of the state's total surface area. Truly streams are scarce and important systems that should receive proper protection.

The Wyoming Game and Fish Department has the responsibility for managing fish populations in Wyoming--as wildlife are property of the state, but BLM is responsible for management of the habitats for many of these fisheries. The large percentage of public land in Wyoming demands integration of land management agency actions affecting habitat and state actions affecting populations. . . if aquatic wildlife are to have a future. To compound overlaps in jurisdiction, the state presently owns the water in Wyoming but fails to recognize the state's wildlife as beneficial users of these waters. The net result is that a water right cannot now be obtained for fisheries instream flows in Wyoming. I purposely use the terms instream flows instead of minimum flows because of negative aspects associated with the term minimum flow. Minimum flows may be just that--the very minimum for fish survival or worse--the absolute minimum of no water! Instream flow needs for fish on the other hand are geared more toward actual fisheries needs and achieving specific management goals.

In January, 1977, the State of Wyoming initiated a general adjudication of all water rights within Water District No. 3--consisting primarily of the Big Horn River Drainage. This lawsuit involves approximately 28,000 litigants. Every person, including the U.S. Government and the Indians, who claims any right to use water in District 3 must present and defend, if necessary, his claims in court. Recognizing the need to consider fisheries instream flows, the BLM contracted with the Wyoming Game and Fish Department to quantify instream flow needs for the species managed by the Department. Results of this quantification will be provided to both the BLM and State Attorney General's Office. → ¶ Multiple transect--incremental flow methodology used in this project was developed by the USFWS Instream Flow Group in Fort Collins, Colorado. The Game and Fish Department has been involved with these methods and their development since inception of the Instream Flow Group and has previously tested the methods on a variety of streams in the state. Although incremental methods currently available are far from perfect and are quite data intensive, they represent significant advances over previously available methods.

Incremental methods have the advantage of allowing a quantitative display of the habitat changes associated with different flow regimes. This has been a major shortcoming of other methods. Through use of incremental instream flow methodology, and cooperative efforts between BLM and the Wyoming Game and FishDepartment, we hope to prevent further stream degradation through dewatering on BLM lands.

A series of 52 slides was presented and narrated to cover the following topics:

1. Overall fisheries management concerns of the Wyoming Game and Fish Department.
2. Display of dewatering problems.
3. Study area for the project.
4. Methods for instream flow determination - IFG4 and WSP.
5. Field work to obtain necessary measurements and problems encountered.
6. Major parts of data processing.
7. Results.
8. Development of realistic flow recommendations from the results.
9. Summary.

Rocky Mountain Regional
Soil, Water, Air Workshop - Jackson, Wyoming
February 2-6, 1981
Royal G. Holl

208 Review and Update

A. Function of two liaison positions

1. Water Resources Policy Staff (211) BLM - W.Q.

Dave Green from EPA to BLM

2. Water Division, EPA, Region 8, Denver.

Royal Holl from BLM to EPA.

- Water quality planning and program implementation (208).
- Hazardous waste disposal relating to water quality on the public lands.
- Water quality-livestock grazing relationships. Matters relating to livestock grazing on public lands will have input from the Division of Rangeland Management.

B. Hazardous Waste

1. Resources Conservation and Recovery Act of 1976. This law imposes strict controls over the management of hazardous waste throughout its entire life cycle.

2. EPA regulations became effective November 19, 1980. Permit required to generate, store, or move hazardous wastes.

3. BLM must comply as agency having jurisdiction over public lands. Equally responsible with operator-lessee who is developing resources.

4. Greatest concern on public lands is ground water pollution.

5. Minerals program, oil and gas leasing, and R&PP disposal sites are areas where BLM is most likely to be involved. BLM not greatly involved at present.

6. Congress has placed a 3½-year moratorium (exclusion) on enforcement for mine wastes, during which time waste disposal relating to mining is to be studied.

7. Uranium mining was excepted from the moratorium.

8. Waste oil was recently classified as hazardous; therefore, it can no longer be used in the oil fields for road surfacing.

9. Herbicides used on the public lands are exempt as they are classified as agricultural chemicals which have a separate classification under RCRA.

C. 208 Program Review

1. Movie: "Non-Point Source - 1983."

2. Federal Water Pollution Control Act (1972) and the Clean Water Act (1977).

3. Requirements - This legislation reflects national concern over the deterioration of the Nation's waters. Concern is directed at public agencies as the private sector. Section 313 states:

> "Each department, agency or instrumentality of the executive, legislative, and judicial branches of the Federal Government (1) having jurisdiction over any property or facility, or (2) engaged in any activity resulting, or which may result, in the discharge or runoff of pollutants shall comply with Federal, State, interstate, and local requirements respecting control and abatement of pollution to the same extent that any person is subject to such requirements. . . ."

Executive Order 11752 is even stronger in stating that Federal agencies will comply with standards in order to meet the objectives of the Act.

The Environmental Protection Agency has the responsibility to insure that Federal agencies, such as the Bureau of Land Management, will make an effort to meet the requirements of the Act.

4. Objectives - Section 101 states, "The objective of this Act is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters." Attainment by (1) eliminating discharge of pollutants into navigable waters by 1985, and (2) where attainable and feasible, reach an interim goal of water quality by July 1, 1983, which provides for protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the waters of the Nation.

5. States are required to establish water quality criteria and standards, which, when approved by the Administrator (EPA), will be federally recognized. BLM is required to meet State standards if more stringent than EPA approved standards.

6. States were required to develop areawide or statewide plans (in cooperation with Federal agencies) which identified problems and provided direction and framework for correcting problems. These plans have generally been completed but are to be updated periodically. BLM should participate in these updates by providing data for the public lands that was not available for the original plan; e.g., watershed management plans and other recent data generated by the planning system.

7. Currently in implementation stage which involves the development of abatement measures and pollution controls; i.e., the adoption and application of best management practices (BMP's) for nonpoint sources.

8. Agreements should be developed between State 208 agencies and BLM to carry out water pollution control measures on public lands with BLM designated as the management agency.

9. Funding for remedial measures on public land. After problem watersheds on public land have been identified through the Bureau planning system or a specific watershed plan and included in an areawide or statewide 208 plan, funding requests for corrective measures will be included in the BLM budgetary process. If funds are not forthcoming through this procedures, the Bureau can go to Congress for specific project funding under Section 313, which authorizes funding to other agencies. To date, OMB has not supported this avenue and Congress has not seen fit to appropriate funds, but neither has BLM pursued this possibility. Until we submit a proposal to Congress and receive a turndown for funding, we are subject to charges of nonconformance with provisions of the Clean Water Act; i.e., making no effort to alleviate nonsource pollution coming off of the public lands. Once Congress rejects funding for remedial action on recognized problem watersheds, the Bureau has fulfilled its obligations under the Act for that fiscal year.

D. State Water Quality Assessment Update, Section 305(b), Clean Water Act. Currently the States in EPA Region 8 are submitting water quality assessment updates. BLM should participate in this effort by identifying problem watersheds on the public lands for inclusion in the States' assessment. Generally, these would be those watersheds where critical erosion is causing significant water quality problems. Areas contributing significant salt loads should be identified also.

It is suggested that State Hydrologic Unit maps (developed by the Water Resources Council) be used as base maps to outline problem watersheds. Watersheds producing serious sediment loads can be outlined in brown and salt producing areas in red. Include a brief description of causative agents, if known; e.g., geologic, grazing, ORV, mineral development, combinations. Prioritization would be appreciated also.

This will give us a good visual display of problem areas in each State. When completed, I would like a copy sent to me at:

EPA Region VIII
Water Division
1860 Lincoln St.
Denver, Colorado 80295

If questions arise, my phone number is FTS 328-4963 or commercial 303-837-4963.

A list of EPA contacts for Region 8 is attached.

WATER DIVISION

Planning and Management Branch

Patrick J. Godsil, Chief. FTS 327-3886. Commercial 303-837-3886.

Implementation Section

FTS 327-4963. Commercial 303-837-4963

Dale Vodehnal, Chief
Ron Eddy, Clean Lakes
Royal Holl (BLM), Grazing Non-Point Source
Bruce Lindahl (SCS), Agriculture Non-Point Source
Bob Mairley, Sec. 404 Permits, S. Dak., Utah, Wyo.
Brad Miller, Sec. 404 Permits, N. Dak., Colo., Mont.
Sherry Millard, Environmental Protection Assistant, Non-point Source Newsletter
Gene Reetz, Hydrologic Modification, Water Resource Management, Colorado River Salinity
Dave Shanks, Agriculture, Silviculture
Tom Willingham, Water Quality Standards
Diane Wynne (327-2721), Water Quality Assessment 305(b), Clean Lakes

Water Quality Management Section

FTS 327-2721. Commercial 303-837-2721

John Tucker, Chief
Rick Claggett, Project Officer Colorado 208-106
Roger Dean, Project Officer S. Dak. and Utah 208-106, Ground Water
Ken Norman, Assistant Project Officer Utah
Mike Strieby, Project Officer Wyo. and N. Dak. 208-106
Bruce Zander, Wasteland Allocation, Urban Runoff
Max Dodson, Project Officer Montana, Helena 406-449-5486

WATER QUALITY AND WILDLAND RESOURCE MANAGEMENT

ALAN F. GALBRAITH[1]

INTRODUCTION

The past 10 years for the Forest Service and other Federal land management agencies will be remembered as the decade of environmental awareness. The Federal Water Pollution Control Act of 1972 and later the Clean Water Act were an outgrowth in the water resources field of this widespread public interest in the quality of our environment. On the Bridger-Teton National Forest (BTNF) this environmental mandate required taking a new look at the potential effects of the traditional natural resource programs upon the quality of lake and stream waters. The BTNF is unusual in possessing a wide range of regionally and nationally important resources represented by the renown big game populations of the Jackson Hole area; headwater watersheds of the Snake, Green Yellowstone, and Bear Rivers; livestock ranges supporting over 100,000 head of cattle and sheep; diverse recreation pursuits such as unparalleled fly fishing in the Teton Wilderness, nationally recognized backpacking in the Bridger Wilderness, or whitewater floating of the Grand Canyon of the Snake River; a recent wave of oil and gas exploration in the "overthrust belt" much of which occurs on the BTNF; and lastly a locally significant timber harvest program. To evaluate the water quality implications of these diverse activities, the decision was made to concentrate upon those programs which were widespread or would become more extensive in the future. Another question revolved around the choice of a site specific activity analysis as opposed to a baseline approach. It became apparent that the logical first step was to answer the question, "Is an adverse change in water quality taking place as a result of the resource use in question?" As a result the water quality evaluation on the BTNF, adopted in a Teton County 208 program, dealt with identifiable activities rather than stream or lake background studies for the most part. This paper will review the results of water quality investigations carried out on the BTNF since the program was initiated in 1975.

---

[1] Forest Hydrologist, Bridger-Teton National Forest, Jackson, Wyoming.

OPEN DISCUSSION

Water Group
Wednesday, February 4, 1981

Problems:

1. Manuals need updating to reflect new regulations, etc.

   Solution: Develop task force to review all manuals for adequacy.

2. New hydrologists need training in Bureau procedures, etc.

   Solution: (a) Experienced hydrologists should rotate around field offices to train new hydrologists.

   (b) Develop training school similar to Lands, Minerals, Wildlife, and Range schools in Phoenix.

3. Need manual completions and Development:

   a. Floodplain manual
   b. Water source inventory manual
   c. Water rights manual
   d. Water resource inventory manual
   e. Hydrology requirements for coal ES
   f. Hydrology requirements for Range ES
   g. Hydrology requirements for RMP process
   h. Post ES monitoring manual.

Work Assignment Records (WARs) for FY 81

R. Clark, DSC (460)

Title: Use of Landsat Imagery Data Interpretations on Grassland - Sagebrush Ecosystem

Objectives:

1. Evaluate the feasibility of using Landsat digital data and compatible digital terrain data to map present vegetation.
2. Evaluate the utility of mapping SWA's using present vegetation map information, merged with range site delineations derived from digitized soils information.
3. Establish guidelines for Phase II implementation of Landsat information in the SVIM process.

Title: Finalization of ASVT

Objectives:

1. Publication of Arizona and Idaho Verification of Resource Information.
2. Evaluate products.
3. Perform cost analysis.

Title: Landsat Classification for Soil-Vegetation Inventories

Objective: Landsat and ancillary data use for development of maps to be used for soil-vegetation surveys in Havasan and Phoenix Resource Areas, Arizona.

Title: Rangeland Monitoring Studies

Objective: Review, revise and update procedures.

Title: Continued Development and Refinement of SVIM

Objective: To refine present SVIM procedures and develop alternative inventory intensities.

Title: Video Tape and/or Slide Tape Series on Inventory and Monitoring Procedures

Objective: Preparation of a series of Video tapes and/or slide tapes for field office and general public information.

Title: Universal Soil Loss Workshop

Objective: Investigate and develop a procedure for application of USLE.

Title: Coordinated Water Use Inventory Manual and Handbook

Objective: Finalize inventory procedure and ADP data management system commensurate with Bureau water rights policy.

Title: Manual 7210 - Hydrologic Inventory - Implementation Procedures

Objective: Develop training program and handbook for implementing Manual 7210.

Presentation at Rocky Mountain Soil, Water and Air Meeting, Jackson, Wyoming. By Ronnie D. Clark

Soil-Water-Air Resource Meeting
Jackson, Wyoming
February 2-6, 1981

Soil characterization and production potential. Wednesday, February 4, M. B. Rollins, Montana State Office Soil Scientist.

A. BACKGROUND

1. Soil surveys on Montana public lands are nearing completion. At this point, key typical soils need additional characterization, chemically and physically. This will provide a better basis for forming sound land use plans and implementing effective management as charged by the Federal Land Policy and Management Act of 1976 (Public Law 94-579) and by the Surface Mining Control and Reclamation Act of 1977 (91 Stat. 507-508). Therefore, it is necessary to gather data on physical and chemical data of important soils and how these properties relate to soil water behavior, nutrient behavior, vegetative character and appropriate land use.

BLM began its soil characterization work in Montana in 1979. In 1980, the State of Montana, in cooperation with federal and other state agencies involved with the National Cooperation Soil Survey, developed a soil survey plan which included the same approach of characterizing soils physically and chemically following soil mapping.

A quote from that plan follows:

"Soils is a natural nonrenewable resource covering most of the land surface in Montana. It is vital to every decision made by individuals or government because the hundreds of different kinds of soils have different responses to use and treatment. To protect Montana's soil resource we must plan to use it wisely. In order to plan to use it wisely we must understand it. To understand it we must study it.

"A knowledge of physical and chemical properties of soils at a location is essential during decisionmaking to maintain or improve soil productivity.

"Interpretation of soil maps to show potentials, opportunities, and hazards of specific uses of land in Montana has hardly begun. Land is still being put to use without a full awareness of its inherent limitations and capabilities."

B. METHODOLOGY

1. General Description

Montana Agricultural Experiment Station personnel were hired under a memorandum of understanding to collect and compile soil information on inherent physical and chemical properties of public land soils. Information was collected to characterize key typical soils from a vegetative productivity and management point of view. Data was gathered from "fence line" paired sites designated by the BLM. Each paired site was of the same ecological (range) site and of the same phase of a soil series but of different ecological (range) conditions.

2. Specific Data Collection

a. Soil data was to be collected on inherent nutrient content, nutrient cycling, water infiltration rates, compaction, erosion, vegetative species composition and annual vegetative production. The Montana Agricultural Experiment Station agreed to:

(1) Conduct a literature review on subjects related to this study and provide BLM with a bibliography and summary of present knowledge.

(2) Measure available nitrogen, phosphorous and potassium; total soluble salts, sodium absorption ratio, pH, alkaline-earth carbonates, organic matter, C-N ratios, bulk density, field and laboratory texture and water infiltration rate.

(3) Determine possible toxic element content in B&C horizons. Check specifically for boron, copper, molybdenum and selenium.

(4) Observe and describe soil structure, paying particular attention to soil surface conditions that would influence water infiltration.

(5) Determine ecological (range) site from phase of soil series, general land form, climate and other environmental factors. Determine ecological (range) condition from vegetative species composition in terms of poor, fair, good or excellent. Measure productivity (and condition) of each site by clipping and weighing each vegetative species.

(6) Measure vegetative ground cover and determine erosion condition class.

More details of data collection are included in the memorandum of understanding, but the most important points are found here.

RESULTS

One of the first points revealed was discrepancies with soil taxonomy.

Of 35 sites examined, 6 of them turned up with discrepancies. This primarily concerned organic matter and acidity outside the ranges of soil taxonomy criteria.

This situation fits one of two conditions; we have either (1) selected nonrepresentative sites (for these 6 showing discrepancies), or (2) these soils indeed need to be classified differently.

Therefore, selection of sampling site becomes extremely important. This is something we have been telling other disciplines - data collection sites need to be selected very carefully. Even soil scientists have something to learn about that.

Another important result was the increase in vegetation production that occurred in plowing a complex of a productive aridisol (paleargid) with sodic affected soils (natrargids). The cause of the increased productivity was two barrelled: First, club moss on the productive soil was reduced by a large amount and, secondly, soil was removed (by plowing) from the productive site and deposited on the sodic soils, giving an overall increase in productivity for the site. Plowing also caused a reduction in nitrogen compared to unplowed native range soils.

Results at this point are skimpy. More significant results will be available when 1980 field data has been analyzed. This will happen in the next few weeks.

In conclusion, Montana public land soils are being characterized to better identify basic resource potentials and constraints. The sites that are established in this work will become valuable comparison areas, as time passes. Because we will have detailed soil information to relate to vegetative production and composition according to certain land use and management practices. This will be useful data to implement effective management.

Rocky Mountain Regional Soil, Water
and Air Resource Workshop
Jackson, Wyoming - February 4, 1981
Presented by Glen Rose (WSO)

Emergency Fire Rehabilitation (EFR)

The main things I want to cover in my talk are those items you must consider in preparing your Emergency Fire Rehabilitation requests (EFR). Your goal is to keep the EFR as brief and concise as possible, while documenting you are going to take fast aggressive, cost-effective actions to protect the soil and water resources of the burned area.

I will be working from the draft revised EFR Manual (7441). However, I certainly will not try to give you the whole shot. No one knows when this Manual will be finalized but the Divisions of Budget, Wildlife and Range have given their blessing so it is now in use.

I will now endeavor to define EFR for you. EFR is a combination of emergency actions that are promptly taken after a wildfire to minimize:

1. Loss of vegetative cover for watershed protection.
2. Loss of soil and on-site productivity.
3. Loss of water control and deterioration of water quality.
4. Damage to property on and off site.
5. Invasion of burned areas by highly flammable weedy plants which produce critical reburn problems.

Restoration Versus Rehabilitation

In general rehabilitation is emergency actions taken to minimize the damages to the area and offsite.

Restoration is actions taken to restore the area to its preburn condition.

The significance of these definitions is that emergency rehabilitation is done with emergency rehabilitation funds (subactivity 4630) and restoration is done with your regular funds through the programming system.

Damages resulting from the suppression actions are done at the end of the suppression actions under subactivity 4620 firefighting funds.

What are acceptable EFR activities:

--Protection of burned area for two (2) growing seasons.

Fencing-new or maintenance.

Barriers-Roads, trails, rimrocks, etc.

Water system closure or relocation.

--Seeding & Planting

1. Complete before winter weather shutdown.
2. Do not plant or seed Browse species where the annual precip is less than 15". You can seed Browse species where crucial wildlife habitat is involved (T&E species, wintry areas, etc.).

--Watershed Tillage (on and off site damage)

Furrowing and trenching.

Ripping.

Water control structures.

--Spraying for brush sprouts if needed to protect seeding.

--Do nothing-if supported by field analysis.

Wilderness Study Areas (WSA's - Page 22 of the Interim Management Policy contains provisions that allow for emergency watershed treatment, however, "this treatment must be carried out to the extent feasible in a manner that will not impair wilderness suitability. To the extent feasible, reseeding and planting under emergency conditions will utilize species native to the area and will avoid cross-country use of motorized equipment. Seedings and plantings will be staggered or irregular so as to avoid a straight - line plantation appearance."

However, you can, within a wilderness study area, seed or plant non-native species with motorized vehicles in a square plantation pattern. If your analysis determines that treatment is needed and if this is the only way the emergency treatment can be accomplished within the time available. This is the extreme case to illustrate that first you are charged with rehabilitating burned areas and then you are charged with doing whatever is feasible to protect any wilderness values that may be present.

EFR and Private Lands - Do Not, expend EFR funds on private lands. Even if the fire was BLM-caused, you must wait for the landowner to file a tort claim and further await outcome of that claim before doing any work on private lands.

You can treat private lands as part of the overall EFR project. However, you must get a cooperative agreement and a monetary contribution to cover the cost of treating the private lands before ordering materials or starting any work. In reality, you are using private funds for private lands and EFR funds for public lands.

Special Values

Consideration must be given to special values that could be affected by EFR activities. Consideration must be given to T&E plants and animals, flood hazards, ACEC's, wilderness, prime farmlands, visual resources, archeological and historical values, etc. These can be evaluated by use of a checklist. An example is in one of the handouts.

Developing and submitting an EFR is very easy and to prove this I will go through the 17 easy steps of EFR. I have a handout covering these steps.

SEVENTEEN EASY STEPS OF EMERGENCY FIRE REHABILITATION

Standards for Use of Emergency Funds. Qualification for the use of emergency funds for fire rehabilitation is subject to the following conditions:

1. District managers must assign resource area personnel to a fire team on ongoing fires to advise on fireline construction alternatives and to determine the EFR and restoration needs if the fire reaches Class E size. Additionally, these assigned personnel assist the fire suppression team in planning for fire operations cleanup prior to removal of crews and equipment from the burned area; e.g., as specified in BLM Manual Section 9211.314B4e.

2. Examination. An examination of the burned area must be initiated within 10 working days to determine the need for rehabilitation.

3. The District Manager determines if the services of an interdisciplinary burned-area survey team are required.

4. If district personnel do not have these skills, assistance must be requested from the State Director.

5. Project Supervisor. The district manager will appoint a project supervisor to oversee all facets of the rehabilitations project from its inception through completion.

6. Submitting the Burned-Area Report. Upon completion of its survey and draft Burned-Area Report, Form 7441-1 the team meets with the District Manager and staff to review its findings and recommendations and make changes, if needed, in recommendations. Some factors that may cause a departure from the recommendations are: availability of funds, multiple use or environmental constraints not recognized by the team, and trade-offs in priorities. If the district manager approves the burned-area report, then it is submitted to the State Director for review and approval in accordance with Bureau Manual 7441.51B.

7. Work Planning. If rehabilitation efforts are required, work planning and project design must begin within 30 working days.

8. Environmental Assessment. An environmental assessment (EA) or environmental impact statement (EIS) must be prepared as part of the EFR planning process. The environmental assessment will assess the impacts of the proposed action on archaeological values, wilderness values, and threatened and endangered species. The information developed in the EA may also be utilized in the decisionmaking process and need not be duplicated in other justification documents (e.g., cost-effectiveness analysis, program support documents or program decision option documents, etc.). (See Illustration 4.)

9. Economic Analysis. The State Director must utilize cost-effectiveness analysis if individual EFR plans exceed $50,000 in project costs. (See BLM Manual Section 9522 for guidance and Illustration 3 for analysis summary.) If rehabilitation costs of individual EFR plans are less than $50,000, the use of this procedure is optional with the State Director. However, the State Director must assure, through the Burned-Area Report, that potential onsite and offsite damages are nonexistent or can be mitigated through the EFR. If offsite damages would occur, the survey team (See .3) makes a modified economic appraisal of potential damages to determine significance and/or potential liability if EFR work is not undertaken (e.g., flood control, land stabilization, etc.).

10. Economic Evaluation Alternatives. The burned-area survey determines the complexities, resource values (on-site and off-site), EFR, and restoration needs. Economic effectiveness analysis, when used in the management decision process, provides the least cost and/or most cost-effective alternatives for accomplishing land stabilization and documents other dollar outputs and social benefits, as well as other nondollar outputs. Any analysis must be performed in accordance with procedures contained in BLM Manual Sections 9521 and 9522. See BLM Manual Section 9522 for procedures to evaluate and formulate alternatives.

11. Job Documentation Report, Form 1732-1, must be prepared for each job. Annual Work Plan, Form 1680-1, and Burned-Area Report, Form 7441-1, must be prepared for each proposed EFR Plan.

12 District Submission. All requirements of this Manual Section must be met prior to forwarding Form 7441-1 and Form 1680-1 for review and approval. Proposals which include treatments not authorized within the criteria of EFR work must be rejected.

13. Actual Work. Actual on-the-ground rehabilitation work must begin within 90 days. The State Director may alter this time frame with justification. For example, following the prescribed time frame for an early-season or late-season wildfire could cause EFR treatments to be initiated during an improper planting season.

14. Livestock. Exclusion of domestic livestock from the burn area is critically important for proper rehabilitation. A plan for grazing must be established on the area before grazing is allowed and as a minimum, the area will be closed to grazing for two growing seasons following the seeding or following the fire, in those cases where no seeding is proposed. Livestock operator(s) involved must be issued a notice of closure in accordance with 43 CFR 4120.3. In certain situations an exception to grazing deferment may be considered if the size of the burned area does not justify protection (40 acre burn in a 10,000 acre pasture), where the burn was a "cold" (early spring or late fall), certain annual vegetation areas where no seeding is proposed and certain burned areas where fencing or herding livestock for protection is impractical. Approval of an exception will be based upon the merits of the individual situation.

15. Project Completion. The district manager implements the actions prescribed by the fire rehabilitation plan. EFR accomplishments are reported on Form 1732-1 and Progress Report, 1680-6 within 30 days following the completion of planned and funded work.

16. Evaluation. Previously burned areas must be evaluated periodically. This provides a better record and basis to make future decisions on preplanning and carrying out of EFR work. Seeded areas should be evaluated annually for at least 3 years and in subsequent years as needed to provide meaningful guides to future courses of action. Study plots should be established on the treated burned areas, nontreated burned areas, and nontreated, nonburned areas. These plots are used to measure recovery of seeded vegetative species as well as nonseeded species. Paced transects, the point-toe method, should be utilized to determine the ground cover. (See Manual Section 4412.14D2).

17. Documenting and Submitting the Report. A written report must document the evaluation. The report should include name of team members, cooperators, when evluations were made, areas evaluated, successes and failures of treatments and reasons, recommendations for improvement, recommendations for any additional follow-up evaluations or coordination, and references to other reports ro critiques appropriate to the post treatment evaluation. Send one copy of the report to Director (220).

SVIM DATA INTERPRETATIONS

PRESENTATION AT ROCKY MOUNTAIN REGIONAL
SOIL, WATER AND AIR WORKSHOP

February 4, 1981

By Ronnie D. Clark, Natural Resource Specialist
Division of Resource Inventory Systems
Denver Service Center

SVIM System Components - 5 Major Phases

1. Soil Inventory (Range Site)
2. Vegetation Inventory (SVIM)
3. Field Compilation
4. Data Entry and Processing
5. Vegetation Allocation

I. Soil Inventory

   1. Identifies soils and associated range sites
   2. Soils determine range site and basic vegetation boundaries
   3. Identifies potential based on climax (high seral)

*II. Vegetation Inventory

   1. Mapping (Range Site, SWA and Stratification)
   2. Transect Data Collection - Field Form
      - *a. Step Point Data (Ground Cover, Basal and Canopy) - Form 4412-26, Items 13 & 18
      - *b. Soil Surface Factor Data - Form 4412-26, Item 16

III. Field Compilation - Support Forms

1. SWA Acres (by allotment) - Form 4412-29 (VA)
2. Stratification Data - Form 4412-30 (VB)
3. Ecological Site Description - Form 4412-34 (VR)
4. Suitability for Livestock Grazing - Form 4412-40 (VI)

IV. Data Entry, Processing and Outputs

Report No.	Title
P010	Allotment Level Acreage Information
P020	Allotment Level Stratification Summary
P030	Stratum Level Plant Species List
P120	Stratum Level Ground and Vegetative Cover
P130	Stratum Level Soil Surface Factor
P140	Stratum Level Apparent Trend
P160	Allotment Level Trend and Condition
P170	Summary of Present Conditions

Tom Lukow
WSO-930

Air Resource Program Orientation
(A Suggested Outline)

Discussed below is an outline for presentation of the air resource program to staff and management within the BLM. Some State Office air quality specialists have already initiated or even completed the orientation process with respect to the air resource program. However, many have not and this outline has been designed to assist these air quality specialists in developing their program and to give a common base from which to build the air resource program. Air quality specialists at all levels must direct more attention to developing a coordinated Bureauwide approach to the air resource program and this outline is one attempt to accomplish this objective.

The presentation should take no more than one to two hours. With specific tailoring to fit the audience (their knowledge of air quality, whether staff or management, etc.), the orientation could be presented to BLM at all levels, other Federal agencies, and State agencies.

A well organized air resource program orientation can set the stage for a number of other activities which will allow air quality specialists to more effectively meet the needs of BLM management. Some of the key steps to be taken following an orientation program include:

1. Identification of air quality contacts at all levels in all appropriate agencies.
2. Conducting technical training sessions at District Office levels.
3. Obtaining field input on air resource considerations.
4. Developing a strategy to address field needs.

With some additional thought, I'm sure you can expand and improve upon the ideas presented here.

Participants in developing the outline included:

Chadwick McBurney	Chief, Branch of Biological Resources Wyoming State Office
Jack Kelly	Chief, Division of Resources Rawlins District
Jim Peterson	Air Quality Specialist Montana State Office
Stan Coloff	Air Quality Specialist Washington Office

Bill Wagner	Air Quality Specialist Utah State Office
Tom Lukow	Air Quality Specialist Wyoming State Office

Air Resource Program Outline

Objective: To introduce the air resource program to Bureau staff and management and to identify its role in multiple use management.

I. Why Does BLM Need an Air Resource Program?--Major Legal Mandates

- A. Federal Land Policy and Management Act (FLPMA)
  - 1. Air is a resource to be protected.
  - 2. Requires BLM to assure that our land use planning complies with all Federal and State laws and regulations.
- B. Clean Air Act
  - 1. Established emission standards
  - 2. Established ambient air quality standards
  - 3. Established Prevention of Significant Deterioration (PSD) standards.
- C. National Environmental Policy Act
  - 1. Requires Federal agencies to monitor, evaluate, control, and report on their activities which protect and enhance the quality of the environment.
  - 2. Requires EIS's addressing significant air quality impacts of BLM actions and actions affecting BLM lands.

II. What Role Does the Air Quality Specialist Play in the Air Resource Program?

- A. Monitor, inventory, and evaluate the many climate and air quality parameters needed to adequately characterize and assess the significance of air quality impacts
- B. Advocate air resource considerations in multiple use management
- C. Give technical support where needed
- D. Incorporate air resource program considerations into BLM and other agency and State planning

III. What Other Bureau Resource Programs are Closely Aligned with the Air Resource Program?

A. Soils

B. Water

C. Rangeland

D. Forestry--fire management

E. Energy and minerals

F. Lands and rights-of-way

G. Wilderness

H. Recreation--visual resource management

I. Wildlife

PRESENTATIONS MADE ON

THURSDAY, FEBRUARY 5, 1981

Procedures for Submitting Research Proposals

Phyllis Roseberry- Wyoming State Office

The procedures for submitting research proposals for Washington Office funding were reviewed. The Washington Office funds are only available to fund research (defined as "systematic, critical, intensive investigation directed toward development of new or fuller scientific knowledge of the subject studied"), not literature reviews or inventories. The format for FY 82 research proposals was reviewed. For FY 82 funding, research proposals were due to WO on April 8, 1981. The request for research proposals was made to the Wyoming Districts and SO Divisions in October 1980. They were reviewed by the State Research Review Committee and revised proposals were sent to WO. Presently funded research projects were briefly summarized. They include the Wyoming Stratton Sagebrush Hydrology study in its final year; the Soil, Vegetation and Water Project in Montana; Infiltration, Runoff, and Sediment Production from public lands (development of a hydrologic model in Colorado); and the Reynolds Creek Hydrology Study (Colorado). The FY 83, and beyond, BLM research strategy was reviewed. This involves a task force to study the following strategy: (1) define scientific needs for each objective/decision (done at the field level); (2) consolidate needs statements (WO); (3) review available knowledge; (4) management group decides if research is necessary; (5) a research group plans and manages the research conducted; (6) an information dissemination group (Scientific Information Service) prepares the information in useful forms for decision makers.

F. Roseberr

PROPOSAL OUTLINE

Scientific Objectives

Referenced background summary of previous and current research in the area

Suggested Qualified Scientific Personnel and their affiliations

Hypotheses, Data, and Analytical Techniques

Contributions toward the Bureau's mission that would result from the proposed project

Plan of work and schedule of deliverables

Preliminary Budget*

(Maximum length 7 pages)

---

*All budget estimates should be in as great a detail as possible. This may be in the form of a range of anticipated costs. It should be cautioned that in making cost estimates, outside sources should not be contacted because, in so doing, specific work elements might be disclosed (BLM Manual Section 1513, Preparation and Administration of Negotiated Contracts).

Rangeland Soil Erosion
(SSF) (PSIAC) (USLE)
Collis Lovely - Hydrologist - WO (222)

SSF: Soil Surface Factor

The Primary Concerns:
1. Use of existing SSF (phase 2 data)
2. The scientific validity of the SSF method.

Summary of responses from field questionnaire:

1. 38 responses in all
2. All States, DSC, and 25 of 58 Districts
3. 23 of 38 respondents use SSF for some purpose
4. 10 of 38 respondents don't use at all
5. 5 of 38 respondents didn't state use or nonuse.

A general consensus description of SSF:

> "A subjective, qualitative descriptor of erosion conditions with a variety of problems causing it to be "suspect" within the BLM."

Common Responses:

Plus (a statement considered as positive or good characteristic)

+ A good management tool
+ Good for comparative purposes
+ Only method available for evaluating condition
+ 66% of replies agreed it has some value for evaluating erosion conditions.

Minus: (Comments which seemd to imply negative, bad, or impractical characteristic)

- not quantitative
- very subjective
- variable results, difficult to replicate
- doesn't distinguish accelerated erosion from geologic erosion
- requires technical background and experience to determine and use
- 60% little or no value for trend
- 75-80% no value for quantifying erosion or sediment yields.

Other methods mentioned which are being utilized by various respondents:

1. PSIAC: for sediment yield
2. USLE: for erosion rates
3. WEQ: for wind erosion
4. TPCC: for forest erosion conditions
5. Soil survey data
6. MUSLE
7. Miscellaneous methods.

Future steps for WO 222:

1. Incorporate input from regional watershed workshops.
2. Attend SEA workshop on Rangeland Erosion in Tucson March 1-6, 1981.
3. Develop final recommendations, with help of BLM task force, if needed.
4. Issue appropriate document defining Bureau position to all field offices.
5. Update current Bureau manuals and support development of new methods as needed.

EROSION AND SEDIMENT YIELD PREDICTION METHODS

Method	Purpose	Final Data Format	Level of Applicability*	Origin	Inventory Cost Requirements	Advantages	Disadvantages
Universal Soil Loss Equation (USLE)	Soil loss by sheet & rill erosion only	Tons/Acre	1,2 - Uniform slopes	Ag. Lands in Eastern U.S.	(Moderate) 2 WMs/Million Ac.	Widely Accepted	Empirical formula not adapted to complex slopes, Manual data processing.
Musgrave	Soil loss by sheet-rill erosion only	Tons/Acre	1,2 - Weighted slopes of 20%	Midwest	(Moderate) 2 WMs/Million Ac.	Automated Data Processing	Outdated
Pacific SW Interagency Comm. (PSIAC)	Sediment Yield	Ac.ft./sq.mi. Qualitative Map	1,2,3 - dependent upon physical resource inventory	Pacific Southwest	(Minimal) 0.5 WM/Million Ac.	Fast, Cost efficient Minimal training	Not responsive to specificity
Modified USLE	Soil loss	Tons/Ac. Storage	1-Per storm basis	SEA-Texas Washingon AZ, CO	(Moderate) 2 WMs/Million Ac.	Accounts for probabilities	Empirical formula requires extensive data bank
Soil Surface Factor (SSF)	General Erosion Condition	Map Qualitative	1-Condition rating	BLM	(Minimal) 1 WM/200,000 Ac. (Phase 1) or 1 WM/ Million Ac. (SVIM)	Indicates erosion problems, gives broad condition and comparative data	Subjective, no predictive valve, need training
Soil Survey	Erosion Susceptibility	Map, Qualitative	1-Soil Survey order dependency	NCSS	(Moderate) 1 WM/12,000 Ac.	Soil survey interpretation	Not address erosion condition & soil loss
Wind Erosion Group (WEG)	Wind Erosion Potential	Qualitative Classification	2,3-high velocity wind prone acres	Midwest (Dust bowl)	(Minimal 0.1 WM/12,00 Ac.	Quick Estimate	Soil survey and wind information dependency

Sediment Sampling	Sediment Yield	PPM-mg/1	1,2 Quantitative	USGS	1 WM/10 miles (extreme variability)	Accuracy, site specific	High cost, highly technical requirements
Erosional/ Depositional Feature	Erosion Condition	Qualitative Map-Feature type	1,2 - Typing of frequency & distribution	USGS Circular 715-L Oregon DEQ	1 WM/100,0 Ac. (Moderate	Progressive data base	Training sensitive in remote sensing
Erosion Potential Mapping	Erosion Potential	Qualitative Maps & Matrix	1, 2	USGS Circular 715-L Oregon DEQ	1 WM/300,000 Ac. (Minimal)	Progressive data base	Training sensitive in remote sensing
Stream Stability Rating	Stream Channel rating	Qualitative Classification	1, 2	U. S. Forest Service	1 WM/20 miles (Moderate)	Quick, segment specific	Qualitative
Thermohyet Analysis	Climatic, Geomorphic Province	Qualitative Weathering Process Groups	1, 2, 3, 4	Oregon-208 Planning	Minimal per Climatological data	Regional Geomorphic Processing	National Weather Service Data dependency

*1 = Level 1, Site specific assessment
2 = Level 2, Planning area assessment
3 = Level 3, Regional assessment
4 = Level 4, National assessment

SEDIMENT PRODUCTION AND YIELD IN THE RED CREEK WATERSHED

by

STEVEN HAMP

Bureau of Land Management
Rock Springs District Office

SEDIMENT PRODUCTION AND YIELD IN THE RED CREEK WATERSHED

Introduction

Sediment is a significant factor affecting water quality and channel characteristics in the Upper Colorado River Basin. Sediment in transport decreases the recreational value of water, adversely affects the fishery resource and affects the quality of water and its suitability for human consumption or use in various enterprises. A large price is paid for removing sediment from water used in everyday life.

Problems created by the deposition of sediment are many and equally varied. Harmful materials deposited at the foot of slopes or on fertile flood plains may reduce the fertility of soils, impair surface drainage, and even destroy valuable crops. Sediment deposited in stream channels reduces the flood-carrying capacity, resulting in more frequent overflow and greater floodwater damage to adjacent riparian areas and properties. The deposition of sediment in reservoirs creates a high cost in maintenance.

Sedimentation involves the processes of erosion, entrainment, transportation, deposition, and the compaction of sediment. These are natural processes that have been active throughout geological times, but more recently, also shaped by the activities of man. A principal agent of sedimentation, although not exclusive, is water. More specifically considered are the forces of rainfall, run-off and streamflow.

This paper presents a brief outline of streamflow and sediment transport as is generally characteristic of western streams. A basic understanding of the general concepts of stream behavior is essential to land managers so they are aware of how management actions affect streams. Also, a discussion on sediment yield in the Red Creek Watershed is presented. The aim is to give an understanding of the nature and scope of sedimentation problems in a specific case study, and of some practical approaches to their solution.

Stream Dynamics and Sediment Transport

Streams are dynamic systems that are prone to change and adjustment. This concept is most easily seen in a seasonal perspective. Streams convey their water in different modes depending on high and low flow conditions. At high-flow stage, for instance, the channel may be totally filled or too small, floodplains become water covered and meanders straight to convey the water more quickly. At low-flow regime, they meander sluggishly between channel banks, often filling only a fraction of the total bed, and in some circumstances completely dry up. Different processes are operative in both stream conditions which exemplifies the fact that stream systems are dynamic.

The continuing landform development occurring on the earth's surface and the development of stream systems over time is another perspective of stream dynamics. Changes in channel pattern and shape, as well as the longitudinal profile occur as part of the long term process of stream development. These changes also occur in response to a new hydraulic situation within a relatively short time. A change in slope or an increase in stream discharge, which may be caused by man's activities, requires stream adjustments. For example, if flow changes drastically, the channel often does not meet the new requirements and adjustments must be made through stream erosion processes. Well-known examples are channel bed degradation or channel meandering. The adjustment process can be explained by the concept of dynamic equilibrium.

Dynamic equilibrium is a very useful concept in evaluating stream systems. The concept is not meant to imply absolute equilibrium conditions, only that the stream can adjust to changing situations within a few years. An equilibrium relationship between sediment discharge Qs and water discharge Qw was demonstrated by Emory Lane as a balance:

$$Qs \quad D \quad \propto \quad Qw \quad S$$

where D is the sediment particle size and S represents the slope. This balance, as shown by Lane, illustrates stream adjustment processes. When one side of the balance changes, the other side must adjust to maintain equilibrium. Therefore, alterations in sediment or water discharge require changes in grain size and/or slope (Heede 1980). An example of serious erosion initiated by increasing the volume of waterflow in a natural channel can be seen locally along Bitter Creek near Rock Springs, Wyoming. Dewatering of coal mines upstream caused a significant increase in water discharge which brought about a change in slope and consequent sediment transport. The result is a deeply incised channel with poor channel stability. The resulting sediment was transported to Flaming Gorge Reservoir.

When actual sediment discharge equals the equilibrium sediment discharge, a uniform sediment flow is represented. A non-uniform flow of sediment occurs when the equilibrium condition is interrupted. A stream will attempt to adjust to the differences between sediment transport capacity and actual sediment load. The result is either deposition or increased erosion. Both the actual rate of transport and the equilibrium rate will change but they will tend to approach each other (Heede 1980).

Streams not in a given equilibrium condition will respond by different adjustment processes. Heede (1980) listed several processes in terms of relative time and energy expenditures that help to define channel adjustments. Ordered from small to large energy expenditure, channel adjustments involve changes in: bed form, bed armor, width, channel pattern and longitudinal profile. Adjustment processes are complex and involve other factors such as geology, soils, vegetation, climate and man's activities. An orderly succession of processes, as outlined, may not operate in streams seeking new equilibrium conditions; the most energy-intensive process could be operating by itself (Heede 1980).

In the example of Bitter Creek, the primary adjustment was by a change in longitudinal profile. This is not to say that other adjustment processes didn't occur, just that the most energy-intensive process was dominate. The change in slope gradient was due to poor bed stability and a lack of vegetation to protect the channel banks.

A non-uniform sediment flow will lead to accelerated sediment transport or increased sediment deposition. Sediment in transport can create severe problems. Sediment is transported in suspension as bedload rolling or sliding along the bed and interchangeably by suspension and bed load. The nature of movement depends on the particle size, shape and specific gravity in respect to the associated velocity and turbulence. Damage can be caused by the striking of objects by sediment particles in transport. For instance, bridge abutments and trestle piers may be severely damaged by boulders chipping away at wood or concrete. In addition, transport of smaller particles can cause excessive wear on turbines and pumps.

The more important problems related to sediment in transport involves finegrained sediment carried in suspension. Usually, the greater the sediment concentration, the poorer the water quality. Sediment alone degrades water specifically for municipal drinking water supply, recreation, industrial consumption, and fisheries. In addition, chemicals and wastes are assimilated onto and into sediment particles. Thus, sediment has become a source of increased concern as a carrier and storage agent of pesticide residue, absorbed phosphorus, nitrogen, and other organic compounds, and pathogenic bacteria.

Deposition is the counterpart of erosional processes. Sediment may cause severe damages depending on the amount, character and place of deposition. Deposits that occur on floodplains create numerous types of damages to crops and developments. They may completely bury crops, or infertile materials can reduce the fertility and long-term productivity of floodplain soils.

The deposition of sediment in irrigation ditches and in natural stream channels creates serious problems that are easily recognized in the arid West. Sediment in irrigation ditches reduces the rate and volume of water delivered to irrigated areas. The clogging of diversions and turnouts with sediment also reduces the amount of water available in time of need. The deposition of sediment in our natural stream channels has greatly aggravated floodwater damages. The deposition of sediment in channels decreases the channel capacity and the flood-carrying capacity. This results in higher and more frequent overflows. Floods are quite obvious, but the influence of sediment is often overlooked.

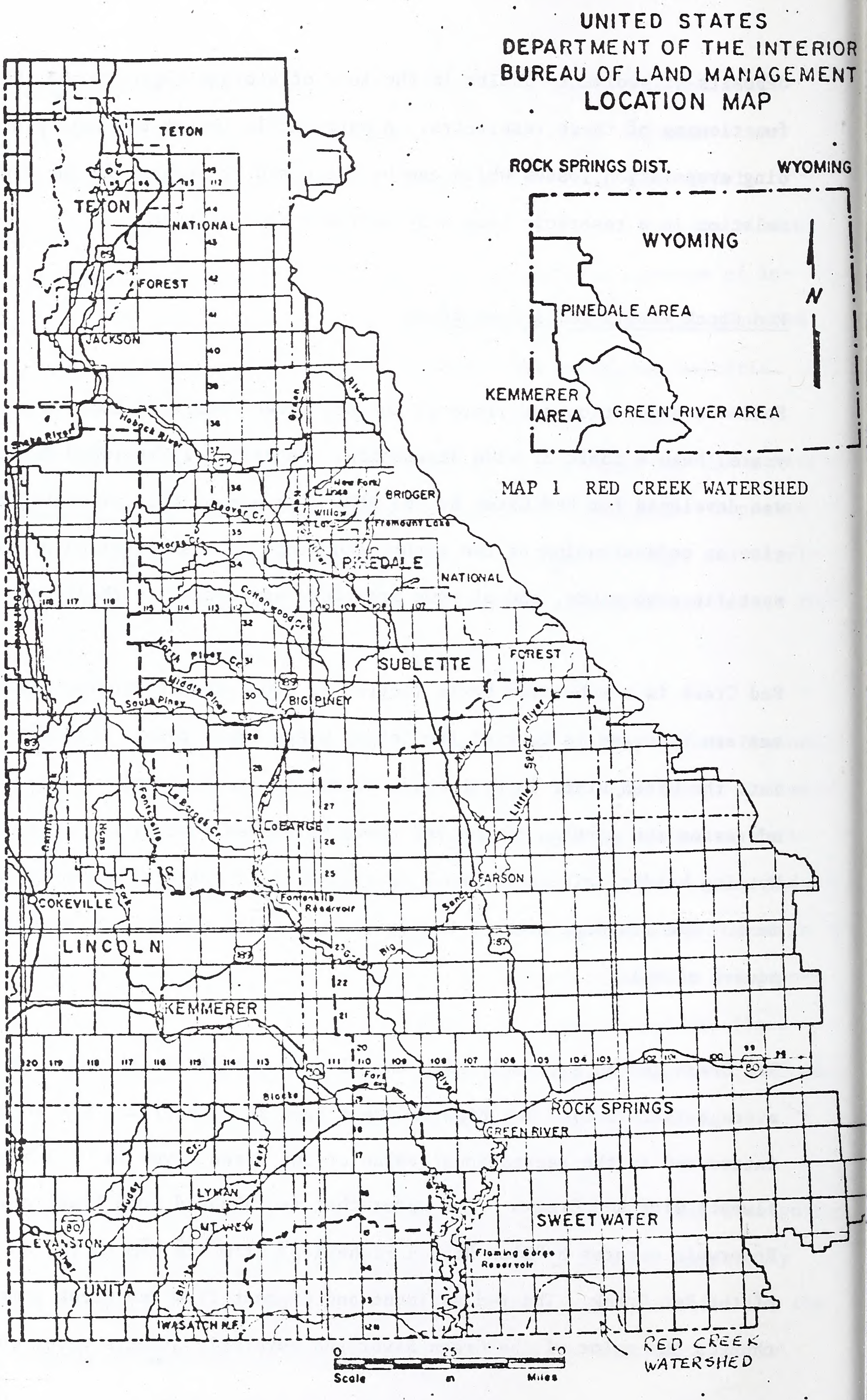
When streamflow enters a natural lake or reservoir, its velocity and transport capacity is reduced and its sediment load is deposited. This is especially significant in Wyoming where the large number of reservoirs were built for the primary purpose of water supply, irrigation and livestock watering. Large deposits of sediment results in the loss of storage capacity and the proper functioning of these reservoirs. A more subtle impact can take place regarding evaporation losses which can be increased by changes in the area-capacity relation in a reservoir caused by sediment accumulation.

Red Creek Watershed: A Case Study

Sediment production and yield in the Red Creek Watershed has, in the last ten years, been a topic of wide discussion. Recently, a Watershed Management Plan was developed for Red Creek by the BLM. The aim of this presentation is to give an understanding of the nature and scope of sedimentation problems in a specific case study, and of some practical approaches to their solution.

Red Creek is a sub-river basin located in southwestern Wyoming and northeastern Utah and is part of the larger Green River Basin. Red Creek flows into the Green River in Utah below Flaming Gorge Reservoir. This discussion addresses the portion of the Red Creek Watershed that is above the Utah-Wyoming border, within the Rock Springs District of the Bureau of Land Management. The drainage area of Red Creek in Wyoming encompasses 67,058 acres (105 square miles).

Red Creek has an extremely high annual sediment yield (84,433 tons/year, average 1972-1976). The high sediment load is a major concern of groups interested in the recreational value of the Green River in Utah below the confluence with Red Creek. The water that is released from Flaming Gorge Reservoir creates a "Blue Ribbon Fisheries" from the dam to the confluence of the Red Creek. The red sediment and pigment from Red Creek immediately changes the color of the Green River and adversely affects water quality and


MAP 1 RED CREEK WATERSHED

value of the trout fishery.

Erosion within the Red Creek Watershed is attributed to natural processes (geologic erosion) and accelerated erosion brought about by man's activity. Historically, Red Creek has been an area of severe natural erosion resulting from the combination of soft bedrock formations, steep topography and precipitation rates and patterns. The rainfall is insufficient to produce dense vegetation and the summer storm events occur as cloudbursts that result in high peak flows. The erosive influence of precipitation is greatest under these circumstances. When the volume of run-off is increased or is concentrated in natural or artificial channels, its erosive energy is increased. The improvement of county roads within the watershed, and improper placement and lack of outlet protection for culverts has initiated severe gullying in several tributaries of Red Creek.

Although upland erosion is a serious problem, channel erosion is also significant in the watershed. Both perennial and ephemeral streams are entrenching into an alluvial terrace. These channels typically have vertical banks with actively eroding gully-like head cuts and poor overall channel stability.

It is necessary to fully recognize and understand the nature of a sediment problem and the part that fundamental sedimentation processes play in creating the problem before an adequate project for alleviation of the problem can be formulated. In Red Creek, the primary concern is the total sediment yield delivered to the Green River. The determination of the various methods for reducing the sediment damages must consider the source and timing of the sediment yield.

Erosion rates on western rangelands are highly variable because of extremes of rainfall, soils, geology, topography, and vegetation. Results from several researchers (Vanoni 1975) support the belief that sheet and rill erosion on these rangelands is generally more dominant than channelized erosion. In Red Creek, the gross sheet and rill erosion over the entire upper watershed is estimated to average 3.5 tons/ac/year, or 245,000 tons per year, while gross streambank erosion for all types of streams is estimated at 92,507 tons per year (SCS 1979). The upland erosion in Red Creek is large, however, in evaluating the watershed in terms of sediment yield, channel erosion is more significant because of the immediate source of sediment to Red Creek.

Sediment yield is the quantity of sediment, as measured by dry weight or volume, that passes a section in a given time. Sediment yield for sheet and rill erosion is estimated to be 10 percent of the gross sheet and rill erosion in the upper watershed, or 24,500 tons per year (SCS 1979). Sediment yield for channel erosion is estimated to be 70 percent of gross channel erosion, or 64,755 tons per year (SCS 1979). In order to significantly reduce sediment yield, the analysis demonstrates that projects should concentrate on reducing channel erosion.

Channel erosion, which includes stream bed and stream bank erosion, is very significant in Red Creek. Accelerated stream bed erosion has caused the lowering of ground water levels and has also triggered downcutting cycles in tributary channels and gullies because of the lowering of the base level. Much of the stream bank erosion in Red Creek has been caused by the clearing of protective cover from banks and from concentration of flow from unprotected culverts, both affect the flow through changes in slope and in stream competence. Streams in the upper part of the watershed can be judged to be out of dynamic equilibrium and are in the process of adjustment. The primary adjustment process involved is a bed profile alteration. Erosion will be severe until natural channelization is achieved and the equilibrium condition is attained. Many of the tributaries to Red Creek are downcutting in response to the lowering of the base level. Gully head cuts are also indicative of the stream system not being in dynamic equilibrium.

Red Creek in the lower portion of the watershed can also be considered in an adjustment process. This section of the stream has already reached a new base level, but is still responding to the high sediment production rates from the upper portion of the stream system. Changes in bed form and channel width are evident. There is an increase in channel bank erosion due to vertical sidewalls and poor channel stability. There is also a large amount of sediment deposited and stored in the channel during low flow conditions due to: (1) increased upland supply, (2) bank caving, and (3) livestock and wildlife movement. The accumulated material is readily available to be picked up and transported by high flows.

A plot of stream flow in cubic feet per second (cfs) versus sediment concentration in milligrams per liter (mg/l) on log-log paper (Figure 1) shows concentration of suspended sediment varies by nearly an order of magnitude with discharge.

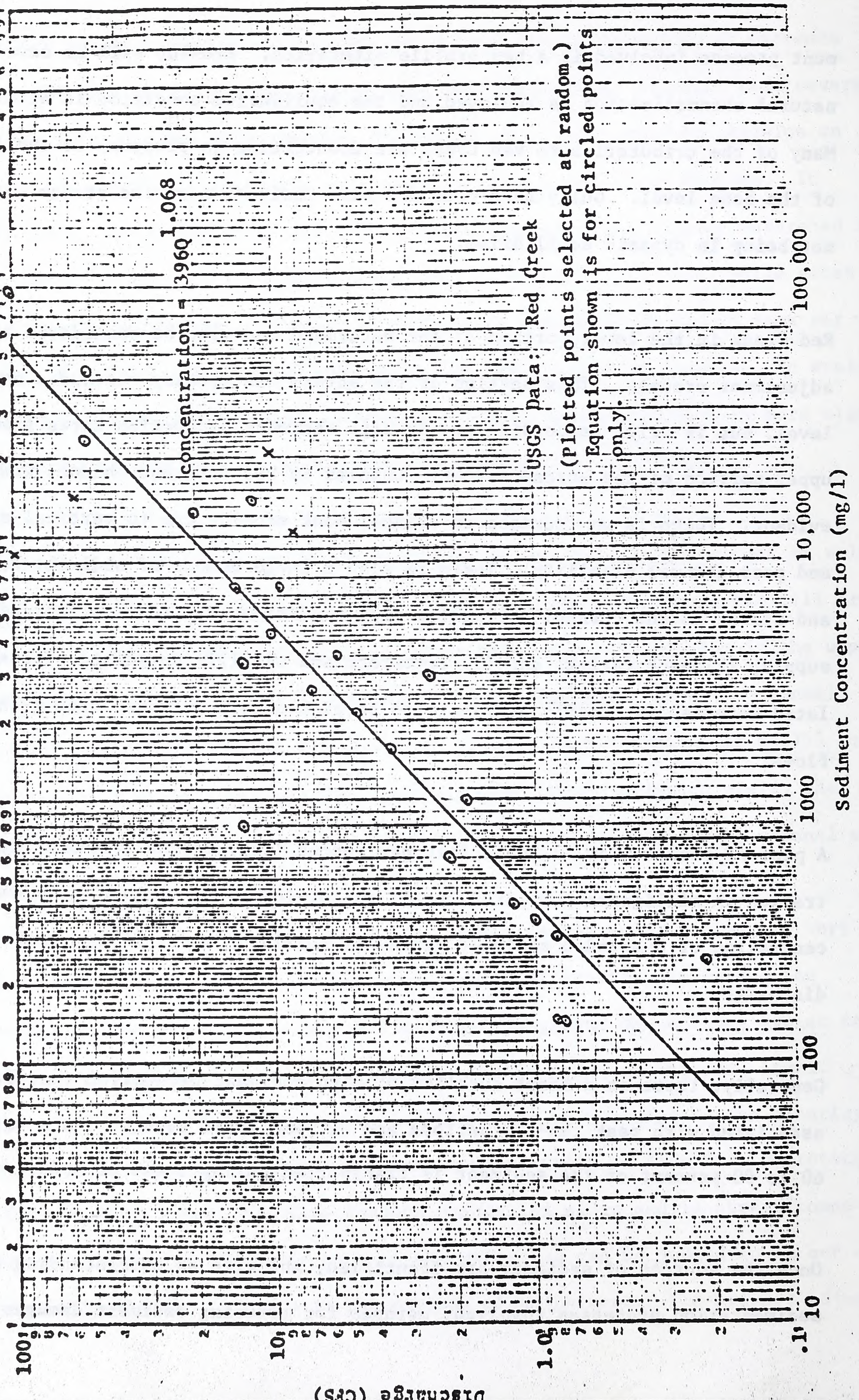
Generally, there is a short duration of high sediment production that is associated with peak run-off periods and extreme storm events. As a rule, 60 to 90 percent of the sediment is transported during these periods.

Once the sources of sediment are identified, and with an understanding of the sedimentation processes involved, methods for reducing sediment damages can be

DISCHARGE vs. SEDIMENT CONCENTRATION

Figure 1

Discharge-Sediment Correlation



From SCS Report, Erosion in Red Creek Watershed, Wyoming; 1979 formulated. The goal of the Red Creek Watershed Management Plan is to reduce the sediment yield delivered to the Green River.

Two of the primary objectives in the Watershed Plan for controlling sediment yield are: (1) to reduce gully erosion, and (2) to improve channel stabilization on Red Creek. The mechanics of gully erosion can be reduced to two main processes: down cutting and head cutting. Down cutting of the gully bottom leads to gully deepening and widening. Head cutting extends the channel into ungullied headwater areas, and increases the stream net and its density by developing tributaries. Gully control through the use of engineering measures, such as check dams and trash catchers, have proved successful in a semi-arid environment (Heede 1977). Channel gradient can be protected with an effective vegetation cover.

Stream exclosures, approximately one to three miles in length, will be installed along Red Creek to enhance natural vegetation recovery and overall channel stabilization. Specific reaches may also require other improvement practices such as planting riparian shrubs that show potential capability for streambank stabilization, installing rip-rap and log drops. The success of the exclosures will be measured using the Stream Reach Inventory and Channel Stability Evaluation (USFS 1975).

Importance of a Watershed Plan

Many problems arising from sediment transport and deposition would be solved by stopping upstream erosion completely. But stopping erosion completely is not always physically possible or economically feasible. A Watershed Plan allows a determination of site specific problems and their solution in a concise format.

In the case study of Red Creek, a knowledge of the amount and character of sediment that, in turn, is influenced by the processes of erosion, transport and deposition was necessary to understand the underlying causes of sediment damages, and to formulate feasible control measures. A Watershed Plan is a desirable format to present this information.

There are basically four advantages in development of a Watershed Plan. One, it allows for a concise statement of the particular problem. Second, it provides a medium to consider and compare solution alternatives. Both of these factors are important in conveying the problem to management, and in making decisions. Third, it allows for coordination between different activity specialists and between other management plans. This assures a multiple-use approach and gives the plan a wider degree of acceptance. Finally, it provides a documentation of the problem and a continuing program for the alleviation of the problem. This is particularly important when considering non-point pollution problems that need to be coordinated with other agencies. Also, many solutions to reduce certain damages require a long-term time frame, and a management plan provides the necessary consistency.

Summary

This paper has presented a brief outline of streamflow and sediment transport as is generally characteristic of western streams. The purpose being that a basic understanding of the general concepts of stream behavior is essential for land managers so they are aware of how management actions affect streams. In addition, a discussion on sediment yield in the Red Creek Watershed was presented. The aim was to give an understanding of the nature and scope of sedimentation problems in a specific case study.

BIBLIOGRAPHY

De Graff, Jerome V., Reducing Man-Caused Gully Erosion, Rangelands 2(5), October 1980.

Heede, H. Buchard, Stages of Development of Gullies in the West, Agricultural Research Service, U.S. Department of Agriculture, 1975.

Heede, H. Buchard, Gully Development and Control: The Status of Our Knowledge, U.S. Forest Service Research Paper RM-169, May 1976, Rocky Mountain Forest and Range Experiment Station.

Heede, H. Buchard, Case Study of a Watershed Rehabilitation Project: Alkali Creek, Colorado, U.S. Forest Service Research Paper RM-189, June 1977, Rocky Mountain Forest and Range Experiment Station.

Heede, H. Buchard, Stream Dynamics: An Overview for Land Managers, USDA Forest Service, General Technical Report RM-72, April 1980.

King, N. J., Erosion Control on Arid and Semi-Arid Rangelands, U.S. Geological Survey Water Resources Division.

Morre, S. John, Erosion in Red Creek Watershed, Wyoming, Soil Conservation Service, Casper, Wyoming, November 1979.

Soil Conservation Service, Soil Survey: Red Creek Area, April 1975.

U.S. Department of Agriculture, Forest Service, Stream Reach Inventory and Channel Stability Evaluation, 1975.

Vanoni, Vito A., ed., Sedimentation Engineering, American Society of Civil Engineers, 1975.

EVALUATION OF THE DISCHARGE AND SUSPENDED SEDIMENT LOAD OF FIFTEENMILE CREEK

1952-1972

By Tom Yochem and Gary Rosenlieb

INTRODUCTION

As early as 1950 the BLM identified the Fifteenmile Drainage as a watershed "in critical condition from the standpoint of soil erosion." More recently, the Big Horn Basin 208 Water Quality Management Plan cited Fifteenmile Creek as one of three major sediment contributing drainages to the Big Horn River. The significance of the Fifteenmile Drainage as a sediment producer is demonstrated in Figure 1, which compares sediment data from a U.S.G.S. gauge on the Big Horn River .5 miles below Fifteenmile Creek during the same water years.

In a memorandum entitled Big Horn Basin Soil and Moisture Conservation Project and Proposal it was stated "Fifteenmile Creek is the number 1 area of the Big Horn Basin in need of erosion cotrol measures. While erosion conditions vary according to soil type and topography, there are serious erosion problems in every section." As a result of the Soil and Moisture Conservation Project, BLM during the 1950s and 1960's constructed several watershed improvements. These included 34 detention dams for the collection and storage of sediment, 110 reservoirs, constructed primarily for watering purposes but also served to store sediment, 21 spreader dikes to distribute runoff over drainage bottoms, and 6,143 acres of contour furrowing. In addition, grazing allotments within Fifteenmile were readjudicated and 14,000 animal unit months of grazing were removed. This process contiued into the 1960's. It is the objective of this evaluation to identify any changes in the sediment load characteristics of Fifteenmile Creek due to natural or management conditions.

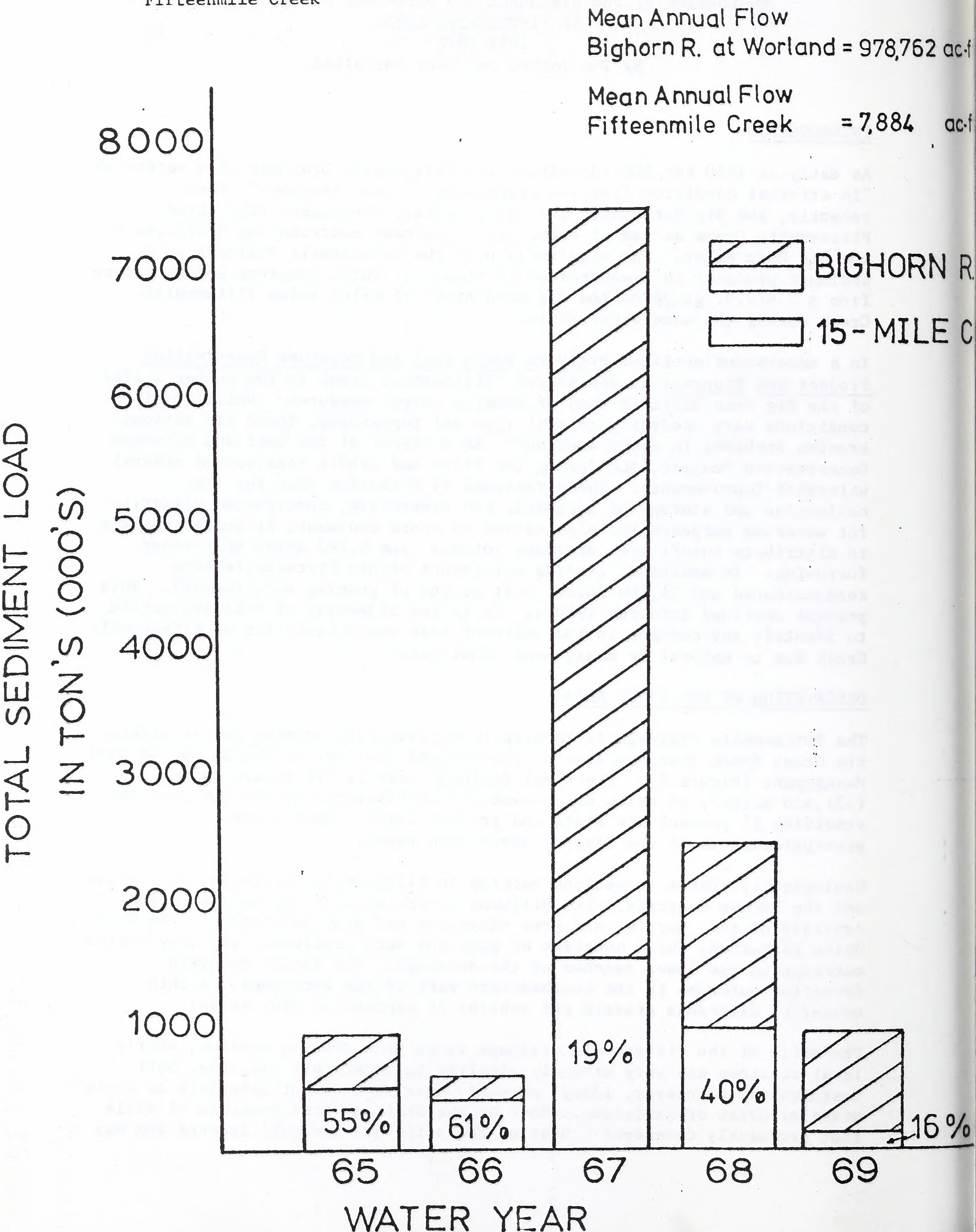
DESCRIPTION OF THE STUDY AREA

The Fifteenmile Drainage is located in northwestern Wyoming and is within the Grass Creek Resource Area of the Worland District of the Bureau of Land Management (Figure 2). The total drainage area is 518 square miles (331,520 acres), of which 83 percent are administered by the BLM, and the remaining 17 percent are state and private lands. Mean annual precipitation is in the five to seven inch range.

Geologically, three formations outcrop in Fifteenmile, Willwood, Fort Union and the Tatman Mountain. The Willwood covers most of the watershed and consists of red, purple, and grey claystone and grey sandstones. The Fort Union Formation, which consists of grey and buff sandstones and grey shales outcrops in the lower reaches of the drainage. The Tatman Mountain formation outcrops in the southwestern part of the watershed. A thin veneer of siliceous gravels and cobbles is exposed on many mesas.

The soils of the Fifteenmile drainage range from deep to shallow, nearly level to steep and very strongly alkaline to moderately alkaline. Soil textures may be clayey, loamy, or sandy over such parent materials as shale mixed alluvian or sandstone. Most of the drainage area consists of soils that are weakly developed. Most of the soils are not well leached and may

Figure 1
Percentage Comparison of Total Annual Sediment load of the Big Horn River and Fifteenmile Creek



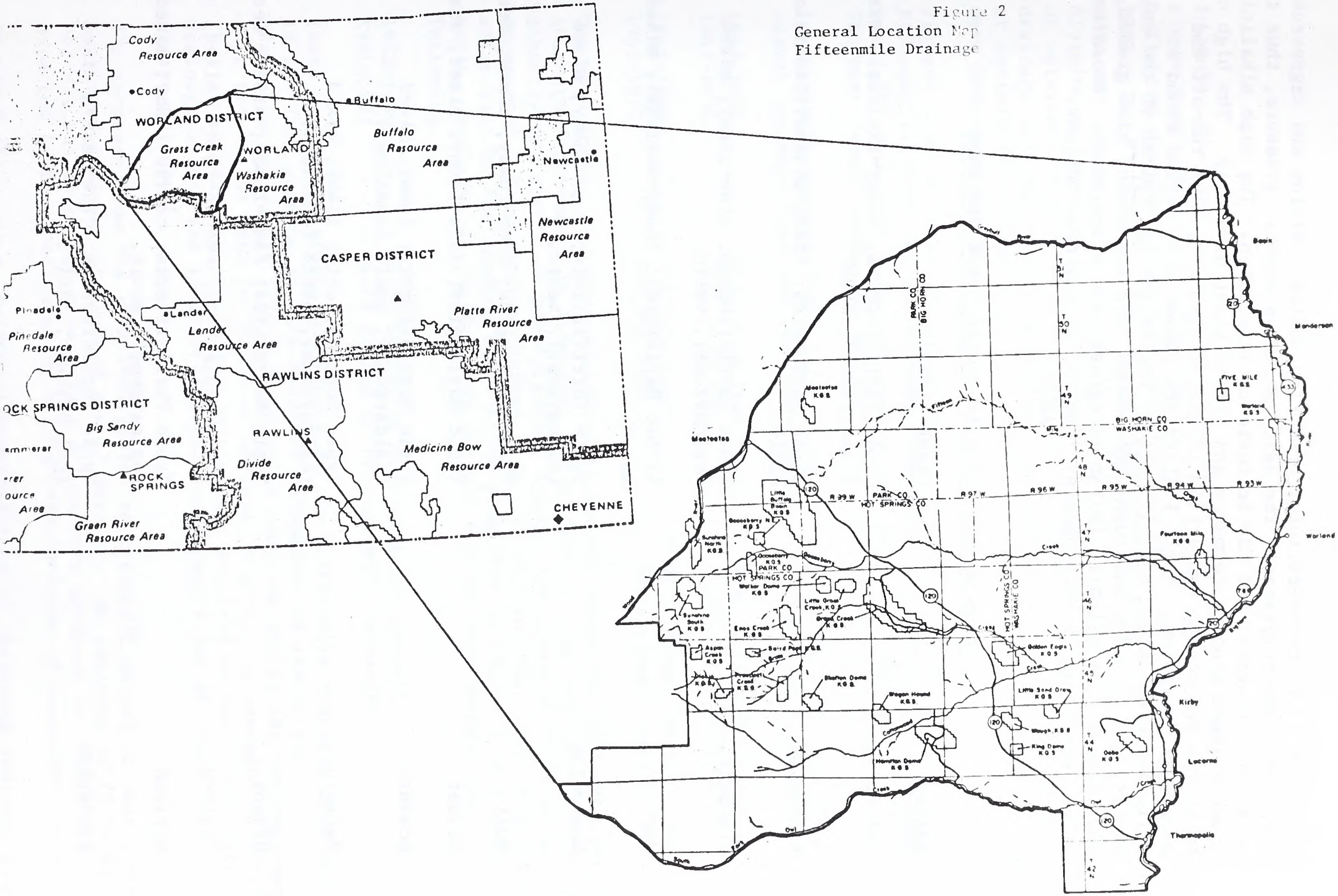


Figure 2
General Location Map
Fifteenmile Drainage

have high salt concentrations, primarily sodium, calcium and magneseum carbonates and sulphates. The salt increases osmotic pressure, thus the soils are droughty, and can be toxic to vegetation. The high alkalinity reduces vegetation performance and limits plant diversity. The high clay soils are subject to compaction if grazed when wet, high run-off and accelerated erosion. Table 1 lists the common soil series found in Fifteenmile and their classification. Vegetation is typical of the cold desert, and includes saltbush, greasewood, big sagebrush, blue gramma, bottlebrush squirreltail, Indian ricegrass, and pricklypear. Broadleaf trees, particularly cottonwoods, inhabit the drainage bottoms.

TABLE 1

Soils Within the Fifteenmile Creek Drainage

Series	Classification
Clifterson	Typic Torriorthents; loamy-skeletal, mixed (calcareous), mesic.
Effington	Typic Natrargids; fine, montmorillonitic, mesic.
Greybull	Typic Torriorthents; fine-loamy, mixed (calcareous), mesic.
Hoot	Lithic Haplargids; loamy-skeletal, mixed, mesic.
Lostwells	Typic Torrifluvents; fine-loamy, mixed (calcareous), mesic.
Muff	Typic Natrargids; fine-loamy, mixed, mesic.
Neiber	Typic Haplargids; fine-loamy, mixed, mesic.
Oceanet	Typic Torriorthents; loamy, mixed (calcareous), mesic (shallow).
Persayo	Typic Torriorthents; loamy, mixed (calcareous), mesic (shallow).
Uffens	Typic Natrargids; fine-loamy, mixed, mesic.
Wallson	Typic Haplargids; coarse-loamy, mixed, mesic.
Worland	Typic Torriorthents; coarse-loamy, mixed (calcareous), mesic.
Youngston	Typic Torrifluvents; fine-loamy, mixed (calcareous), mesic.

DATA ANALYSIS

In March 1951, the U.S.G.S. in cooperation with the BLM established a stream gauge station at the mouth of Fifteenmile Creek, this station collected daily discharge and suspended sediment data until December of 1972. The 21 years of data represented through this time span was divided into two time periods, 1952-1960, and 1961-1972, for analysis. This division is based more on obvious trend emphasis than temporal distribution of watershed improvements because the management changes within the drainage were continuous throughout the time period. However, a majority of certain improvements such as detention dams, dikes, and waterspreaders were completed before 1961.

Figures 3 and 4 shows the annual discharge and sediment loading from Fifteenmile Creek for the 21 years of record. The mean annual discharge was 7,884 acre feet while the mean annual peak discharge was 1,668 cfs. The mean annual suspended sediment discharge was 603,004 tons.

In examining Figures 3 and 4 it is evident that since 1960, the total annual sediment load and the total annual discharge have increased:

1952-1960	5422 Acre Feet	mean annual discharge
1961-1972	9731 Acre Feet	mean annual discharge
1952-1960	548,725 Tons	mean annual suspend. sed.
1961-1972	643,716 Tons	mean annual suspend. sed.

The mean annual discharge increased 79 percent above the 1952-1960 period. Although Fifteenmile is ephemeral and subject to wide variation in runoff, directly the result of precipitation events, the increase of 79 percent was unexpected. Precipitation information from Worland FAA, located about two miles east of the gauging station, is presented in Figure 5 on a water year basis. Analysis of the data for the two time periods reveals the following:

1952-1960	5.54 inches of precipitation annually
1961-1972	6.78 inches of precipitation annually

There were no precipitation gauges on the Fifteenmile drainage from 1952 to 1972. This absence of data makes it impossible to assess the precipitation/runoff relationship which occurred within the drainage during this time. The data collected at Worland, however, is adequate to infer that an increase in precipitation likewise occurred on the Fifteenmile drainage during the 1961-1972 period and accounts for at least part of the increased runoff.

The increase from the 1952-1960 period to 1961-1972 period of mean annual suspended sediment discharged was 17 percent. An increase of 75 to 85 percent was to be expected, since a long-term increase in runoff was expected to be accompanied by a long-term increase in suspended sediment.

Figure 6 illustrates the annual concentration of suspended sediment from 1952 to 1972, and reveals a gradual reduction in concentration from 1952 to 1972. The average concentration from the two periods is as follows:

Figure 5
Annual Discharge from Fifteenmile
Creek, in Acre-Feet

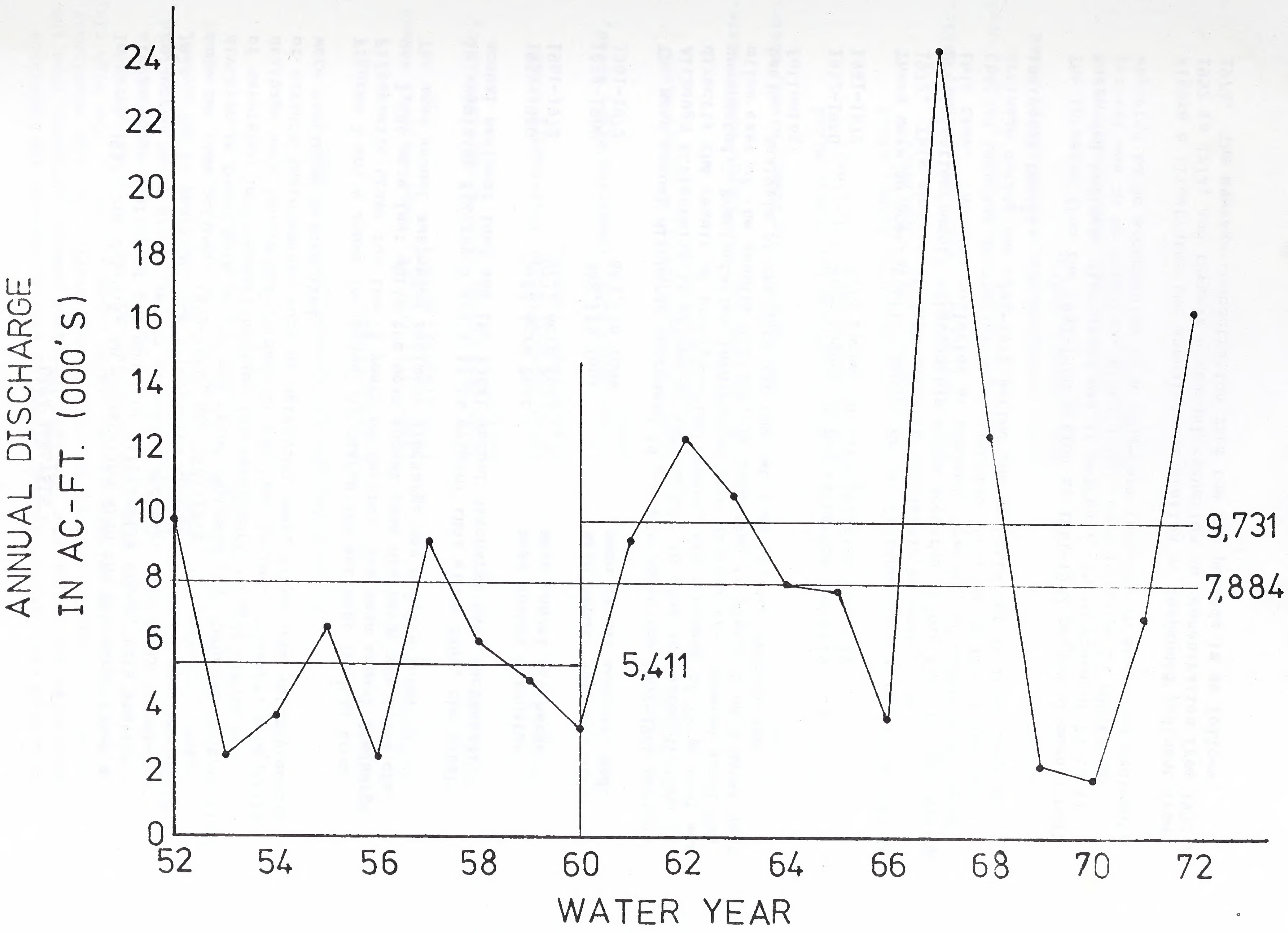
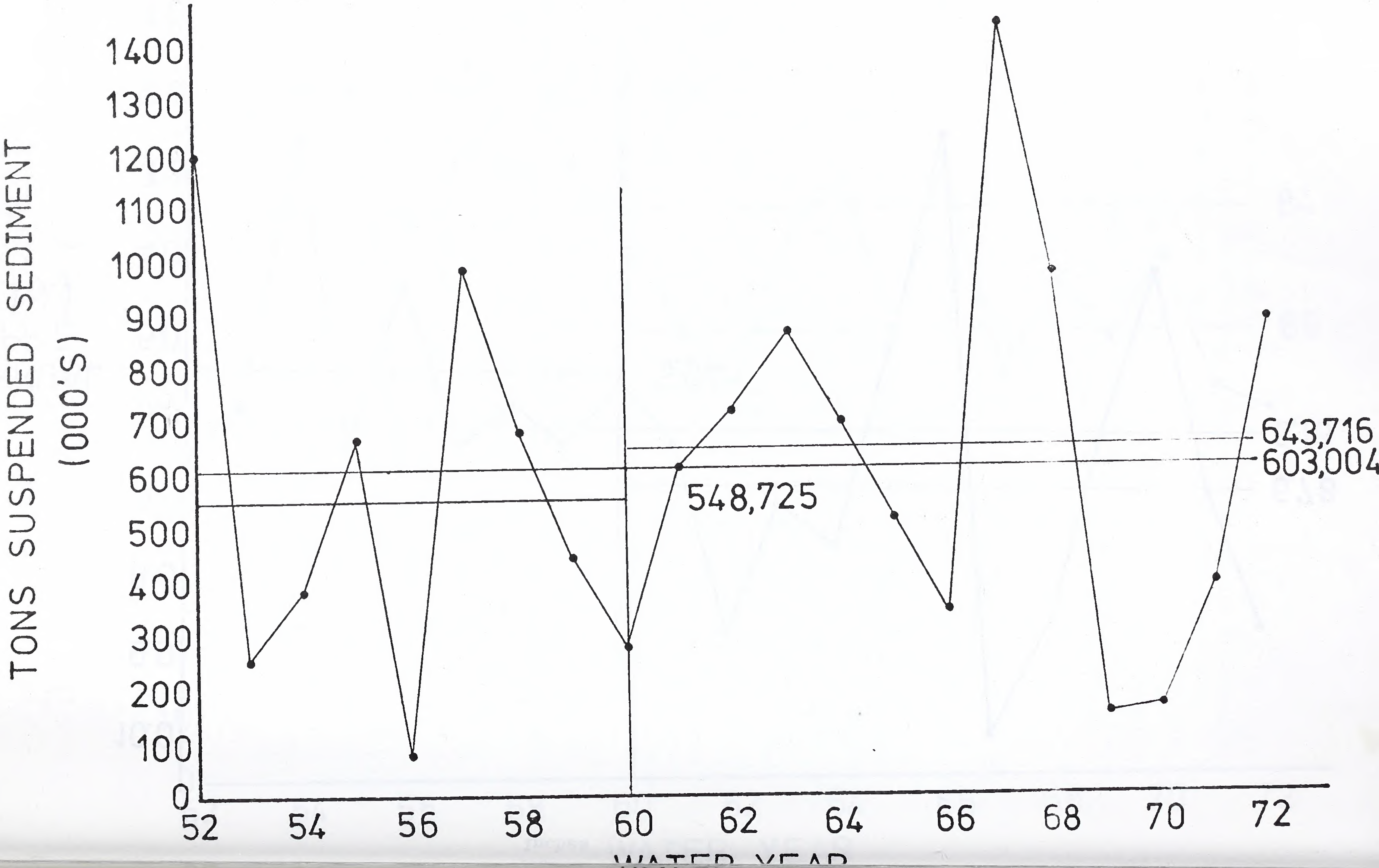


Figure 4
Annual sediment Loading from Fifteenmile
Creek, in Tons



Inches

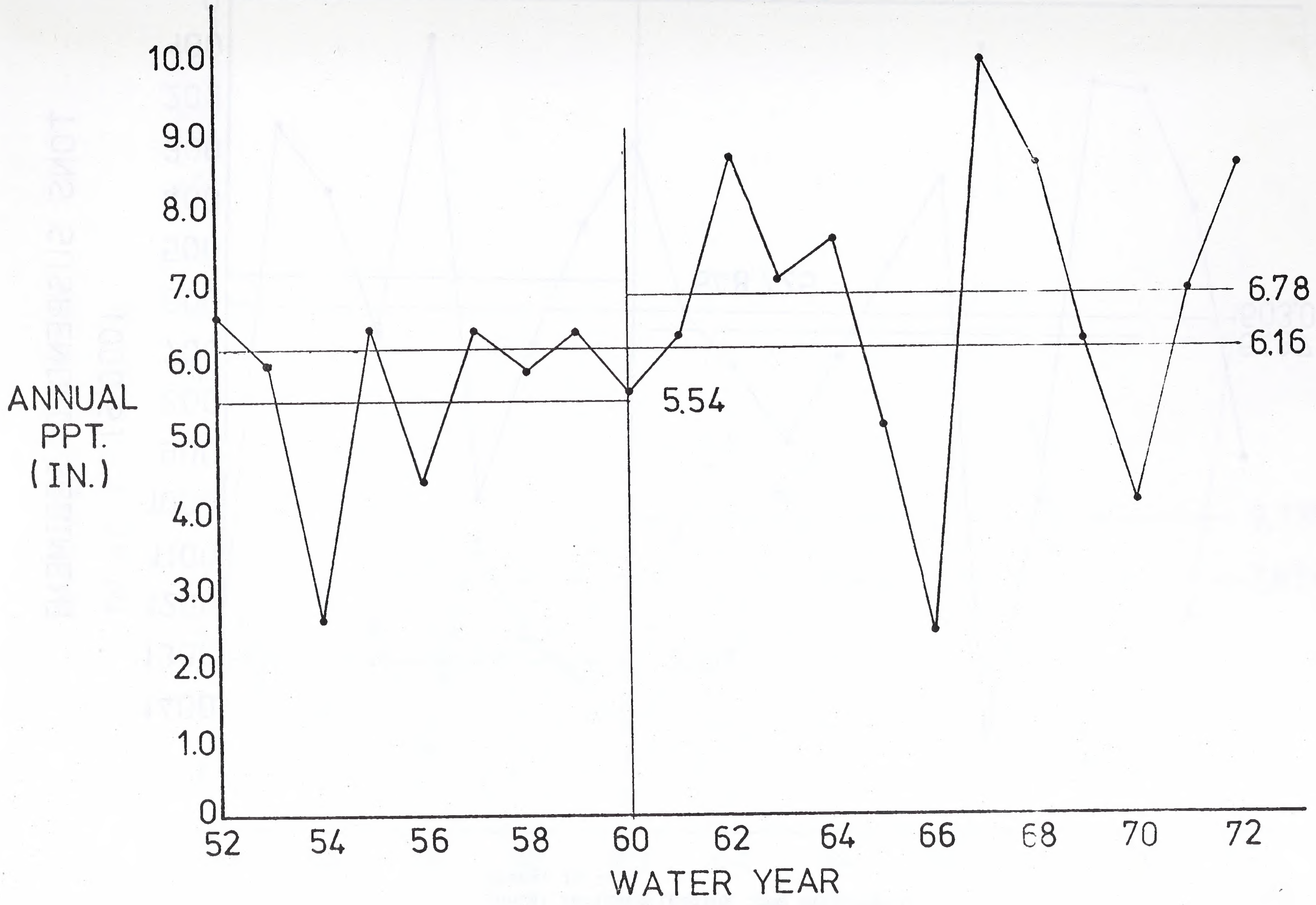
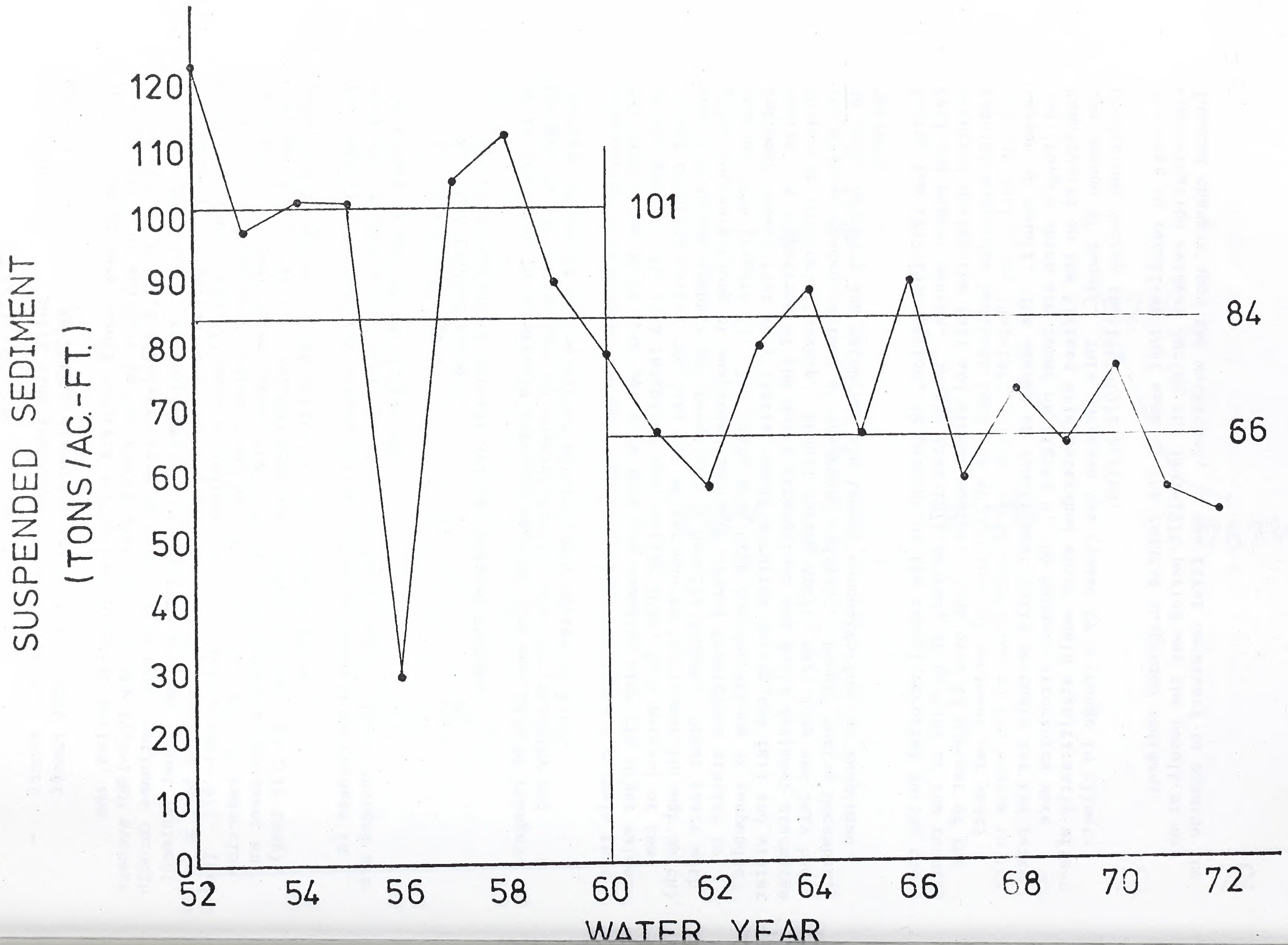

10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
ANNUAL
PPT.
(IN.)
5.54
6.78
6.16
52
54
56
58
60
62
64
66
68
70
72
WATER YEAR

Figure 6
Mean Annual Sediment Concentration
From Fifteenmile Creek in Tons/Ac.-Ft.



1952-1960: 101.2 tons suspended sediment/acre foot runoff
1961-1972: 66.2 tons suspended sediment/acre foot runoff

Thus, although more runoff occurred during the 1961-1972 period, the concentration of sediment in the runoff was less. If the 1952-1960 average concentration of 101.2 tons/acre foot of water would have continued through the 1961-1972 period, the hypothetical or expected average annual sediment load through the period could be computed as: 101.21 tons/acre foot x 9,731 acre feet = 984,777 tons of sediment per year during 1961-1972. The actual average measured sediment was 643,716 tons, thus the 35% reduction in sediment concentration during the 1961-1972 period would represent an average of approximately 341,000 tons/year (984,777 tons - 693,716 tons) reduction in sediment load carried by Fifteenmile Creek.

The reduction in sediment concentration can be attributed to changes in watershed runoff and/or characteristic of the drainage. These changes are the result of one of the following:

1. Natural Changes.
2. Man induced changes.
3. Combination of natural and man induced changes.

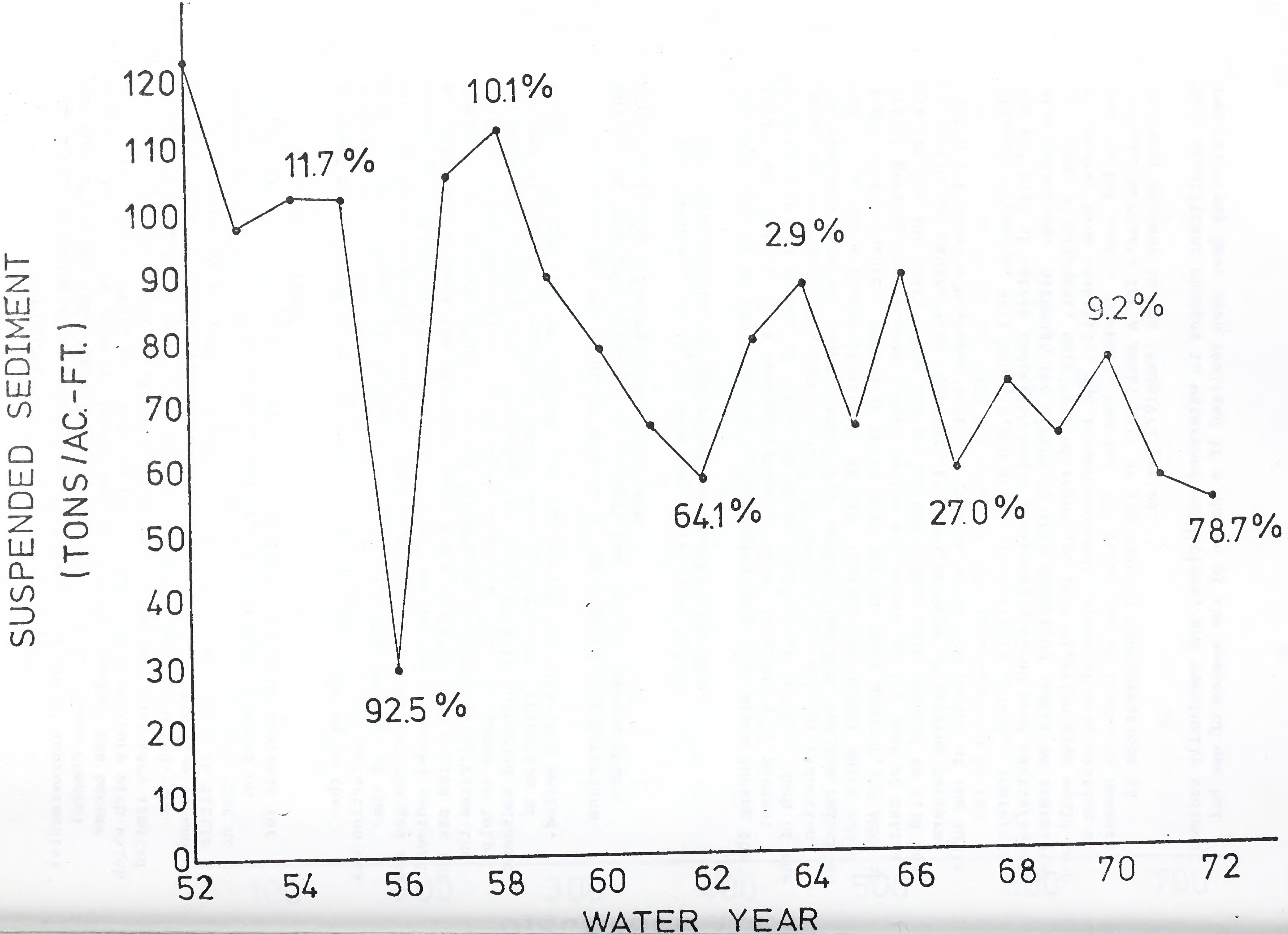
It is difficult to accurately separate natural from man induced changes. Changes in the stream channel characteristics and the intensity and duration of runoff may be either natural, man caused or both.

Examination of suspended sediment concentrations in Figure 6 reveals that the 1956 value of 29 tons per acre foot was anomalus with the other values on the graph. The data indicates that during 1956, 92.5 percent of the runoff occurred during the fall and winter months (September through March) when the stream channel and rangeland is usually frozen. Other years with lower concentrations of suspended sediment showed conditions similar to that of 1956 (Figure 7). The years with high concentrations of suspended sediment showed that very little runoff occurred during the fall and winter months. A comparison of the daily streamflows and daily sediment discharge supported this relationship. Runoff during April, May, June and July had the highest concentrations of suspended sediment. Runoff during December, January, February and March had the lowest concentrations of suspended sediment.

During the 1952-1960 period, 19 percent of the runoff occurred during the fall and winter months. In the 1961-1972 period, 38 percent of the runoff occurred during the fall and winter months. Just over 23 percent of the reduced suspended sediment load (or 80,000 tons of sediment per year) evident during the 1961-1972 period can be attributed to the change in the season of runoff. The season of runoff most fully accounts for the peaks and troughs which are found on Figure 6. No manmade structures were constructed on the Fifteen Mile Watershed which would significantly effect the season of runoff. This increase was caused by a change in climate conditions during the 1961-1972 period.

In order to establish that some of the reduced suspended sediment concentration evident during the 1961-1972 period was the result of man induced changes upon the watershed, it was first necessary to examine the

Figure 7
Mean Annual Sediment Concentration and Percent of Runoff Occurring during Winter Months (September through March)



watershed (excluding those portions which received watershed improvements) and identify significant changes in vegetative cover or stream channel characteristics. Of primary concern was whether the channel has become more stablilized. There were limited photographs and literature with which to identify the changes. All indications were, however, that very limited changes in vegetation density or channel stability have occurred, the stream channel is still extremely unstable. Cutbanks in the fine to medium grain alluvium are evident throughout the main channel. There is little vegetation or debris to stabilize the channel. It was concluded that no significant changes (as related to sediment yield) have occurred on Fifteenmile over the past 25 years and the availability of sediment for transport has not declined.

A comparison was made of similar runoff events which occurred in the 1952-1960 period with those of the 1961-1972 period. Careful selection was made to ensure comparable intensity, duration and time of year of the runoff. By establishing that watershed characteristics had not changed and comparing similar runoff events, any differences in the suspended sediment concentration between the 1952-1960 period and the 1961-1972 period are the result of man-induced changes in the watersheds. Figure 8 illustrates the results of the comparison. A straight "best fit" line was added to help visualize the differences. Computing the difference in suspended sediment concentrations of the selected runoff events indicated a reduction of 80,000 to 90,000 tons of sediment per year during the 1961-1972 period.

This would account for about 25 percent of the reduced concentrations during the 1961-1972 period. The primary man induced changes which occurred in the Fifteenmile watershed are:

1) Reduction of 14,700 AUMs due to readjudication;
2) Construction of watershed improvement structure.

The reduction of 14,700 AUMs due to readjudications took place during the 1950's and 1960's. This readjudication amounted to about a 35 percent reduction in the number of livestock which could graze on NRL. Much of the reduction -- possibly 50 percent or 7,350 AUMs -- was a paper reduction. The ranchers were not running their full adjudicated AUMs and the reduction did not actually remove livestock, it just limited the number which could graze in the future. Over a 10 to 15 year period, only about 7,350 AUMs of actual grazing was reduced. This is the equivalent of 612 head of cattle grazing for one year. Over the entire watershed, this amounts to 1.18 head of cattle per square mile. However, informal surveys of grazing patterns within Fifteenmile Drainage indicate that possibly 40% to 80% of the AUM's are coming out of the drainage bottoms. If this is assumed to be the alluvial deposits, only about 6,000 acres are actively grazed. Therefore the 612 head of cattle reduction would represent a 40-60 head cattle/square mile reduction. Although the effect of this reduction cannot be translated into tons of sediment, this type of reduction in a riparian area would lead to greater bank stability, and lessen somewhat, areas of mass wasting of the channel banks. Overall, however, the reduction in livestock numbers probably accounts for a small part of the reduced concentrations of sediment evident in the 1960-1972 period.

More significant changes in watershed conditions, and eventually sediment reduction may have been realized if a change of the season of use had

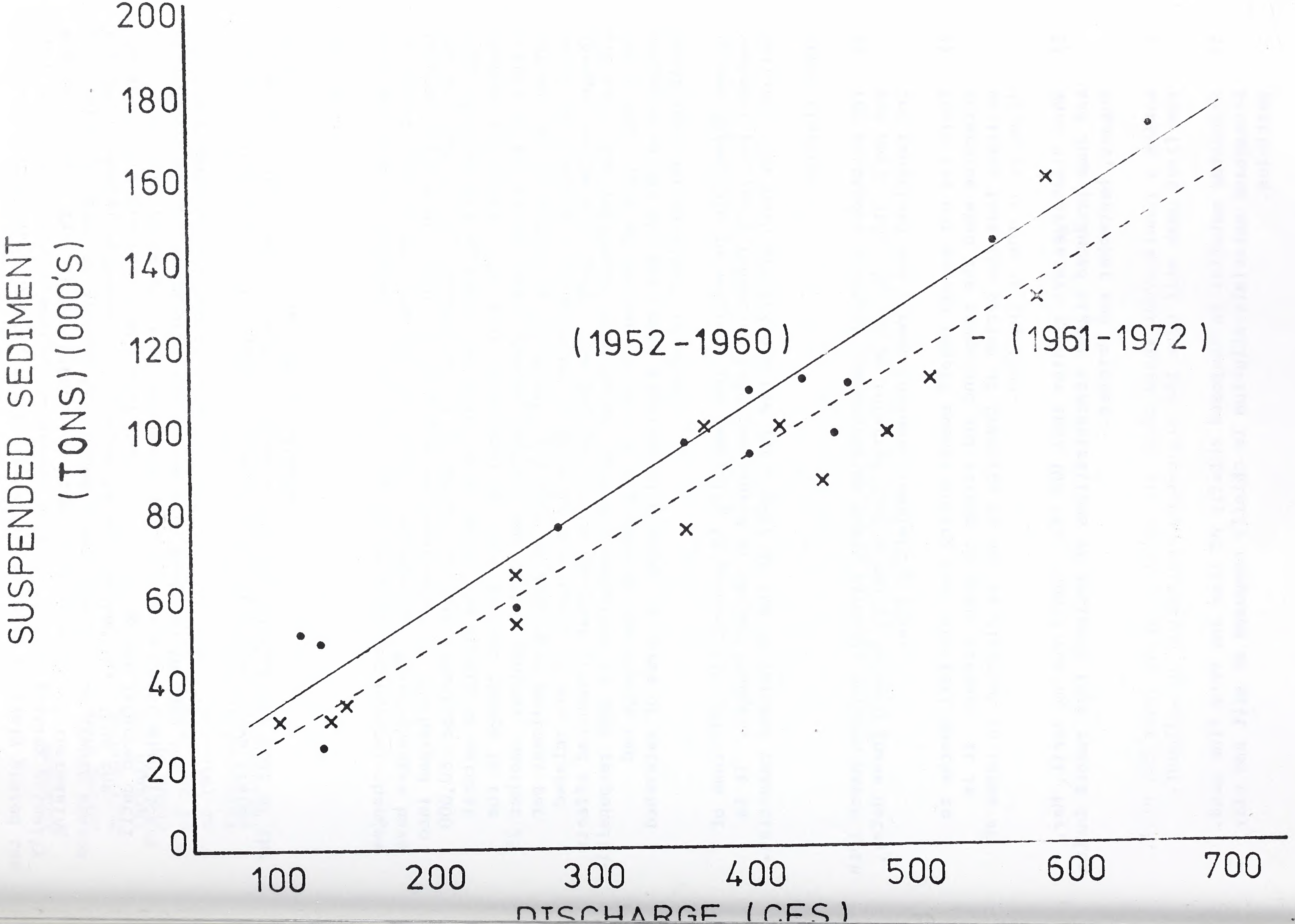


Figure 8
Regression of Sediment Loading Versus
Similar Runoff Events in 1952-1960
Period and the 1961-1972 Period

accompanied the cut in AUM's. Currently Fifteenmile is actively grazed the year around with winter sheep, and summer cattle. Cattle grazing actually begins in May. This is not beneficial from the standpoint of increasing vegetative density, as grazing is beginning when the optimum growth season for the perrenial cool-seasonal grasses is also beginning. Thus the grasses do not proceed to the seed stage. If grazing was deferred until July, when seed heads would be developed on the grasses, more significant changes in vegetative density would have been realized through the 1952-1972 period.

The only other action of significance was the construction of watershed improvement structures. These structures probably account for most of the 25 percent reduction in suspended sediment.

Conclusions

Both man induced changes in watershed characteristics and natural changes in runoff have occurred on the Fifteenmile watershed. These changes have reduced the concentration of suspended sediment which is discharged into the Big Horn River. Approximately 23 percent of this reduction (80,000 tons of suspended sediment per year) is directly the result of natural changes in runoff. The most pronounced of these natural change is the result of increased runoff during the fall and winter months. Another 25 percent of the reduction (85,000-90,000 tons of suspended sediment per year) in sediment concentration is directly the result of man related changes in the watershed. The changes having the most pronounced effects are watershed improvment structures, with the reduction in AUMs responsible for a small part of the reduction. If a season of use change had accompanied the AUM cut, more significant changes in terms of watershed conditions may have been realized.

It was impossible to separate the remaining 52 percent (170,000 tons of sediment per year) reduction into man caused or nature changes. It is believed that both are responsible for a part of the 52 percent reduction.

Other findings:

1) The suspended sediment concentration rises markedly between March 10th and April 5th. It can be inferred that normally between these dates, the rangeland and stream channels completely thaw.

2) There are not enough runoff events during the late fall months to determine when the rangeland and stream channels freeze. It is believed that the period of freezing is not as clearcut in terms of dates as is the spring thaw.

3) When discharges are greater than 100 cfs, runoff during April, May, and June produced higher concentrations of sediment than runoff during August, September and October.

4) During a runoff event where there are miltiple peaks (over 200 cfs), the first peak will have the highest concentration of sediment.

5) Streambed material is composed chiefly of fine and very fine sand. Streambank materials alluvium is chiefly composed of silt and clay particles.

Addendum

Recent cursory inspections of detention dams and spreader dikes in the Fifteenmile area are in a state of disrepair. Breeches headcutting back through the sediment pool of some detention dams appear to be advancing at about 30-50 feet a year at depths of 10 feet or more. The ultimate effect of the failure of these structures on sediment yield cannot be ascertained at this time. However, in 1978, the BLM and the U.S.G.S. reestablished the Fifteenmile gauge. Analysis of this data will be forthcoming and should be included in an updated version of this report.

Livestock Grazing Management and Water Quality Protection - State-of-the-Art

Eric B. Janes, Project Studies Chief,
D-450, Denver Service Center

The Bureau of Land Management (BLM) and Environmental Protection Agency (EPA) have prepared a detailed technical document on the subject for lands of the western United States. It is intended to inform and assist State, Federal, Section 208 planning and management agencies, rangeland and other land managers in understanding the potential water quality impacts associated with grazing and techniques for minimizing impacts. This paper summarizes some of the key elements of the state-of-the-art report.

Best Management Practices for Minimizing Adverse Water Quality Impacts

"Best Management Practices" (BMPs) means a practice or combination of practices, that is determined by a State (or designated areawide planning agency) after problem assessment, examination of alternative practices, and appropriate public participation to be the most effective, practicable (including technological, economic, and institutional considerations) means of preventing or reducing the amount of pollution generated by nonpoint sources to a level compatible with water quality goals (Federal Register Vol. 40, No. 230, November 28, 1975). BMPs also refer to a broader process of identifying practices and techniques that may be used to reduce water quality impacts. It is the latter concept that is used in summarizing state-of-the-art techniques and practices.

Current knowledge of BMPs is primarily based on soil erosion control practices that were developed to reduce soil loss and maintain productivity. The inference is made that if soil erosion is minimized, the technique or practice will be effective in substantially reducing water quality impacts for sediment and related pollutants. For some BMPs there are limited research data to validate this inference. Monitoring the effectiveness of practices is a continuing need for land and water quality management agencies.

Some of the principles that should be recognized in selecting BMPs to reduce water quality impacts from grazing and rangeland treatments are:

1. In many instances there will be several technically adequate alternatives that may be applied to minimize water quality impacts when problems occur.

Presented at Jackson, Wyoming to Bureau of Land Management's Northern Rocky Mountain Regional Soil, Water and Air Meeting, February 5, 1981. The paper summarizes the document produced jointly by the Environmental Protection Agency and Bureau of Land Management. 1979. Livestock Grazing Management and Water Quality Protection (State-of-the-Art Reference Document). 147 p. E. Moore et al. EPA 910/9-79-67.

2. Exclusion of livestock use because of watershed and site conditions may be the BMPs in some instances to minimize water quality impacts.

3. Selection of adequate BMPs may require the expertise of interdisciplinary resource specialist.

4. The most effective protection techniques must be based on site-specific conditions such as soils, vegetation, geology, climate, proximity to water bodies and management objectives.

5. BMPs may prevent as well as mitigate water quality problems.

6. BMPs reflect the concept that a system or combination of practices may be needed on a particular site or planning area.

7. BMPs are generally not designed to mitigate impacts from unusual storm, climatic events or acts of nature. However, water quality impacts are usually reduced in well-managed watersheds.

Summary of BMPs

BMPs are summarized to emphasize their importance in water quality management planning. Rationale for many of the techniques is presented in the detailed document. Some of the techniques identified in the summary represent inferences based on the state-of-the-art assessment and literature review.

a. To implement effective livestock grazing management, basic principles of grazing, vegetation, soils, wildlife, cultural and other uses and resources and their relationships must be understood and used. Although exceptions occur, two important concepts and guiding criteria are:

    (1) In the design or selection of any grazing system, long-term benefits must be considered. Watershed protection must be the first consideration. Watershed protection cannot be sustained on deteriorating rangeland vegetation. The selection, and response to grazing, or key plant species is very important since they reflect the health of the total plant community.

    (2) All uses and resources that affect livestock grazing or that livestock grazing affects must be evaluated. Objectives for each should be determined and conflicts resolved. For example, where wildlife and livestock compete for the same forage, careful planning is necessary to keep a balance between all grazing animals and the forage produced.

b. From the standpoint of achieving livestock management objectives and minimizing soil, vegetation and water quality impacts, grazing management plans will vary. There is no set formula that will identify the type of grazing system or management plan that will be best for any livestock operation or allotment. Water quality impact will be closely related to soil erosion and sedimentation, associated with vegetation density and concentration of livestock grazing. The grazing system must be designed on the basis of soil and vegetation capabilities, water quality considerations and livestock requirements.

c. Ground cover density and size of bare soil openings have the greatest influence on overland flow, soil erosion, and pollutant transport. Research has documented that seventy percent (70%) or above plant cover (standing live and dead vegetation) is an optimum density to reduce erosion, runoff, and water quality impacts from rangelands. From a water quality standpoint, vegetative cover can be manipulated within a range of 70 to 100 percent to maximize forage production and use without a significant effect on water quality. Some semiarid and most arid rangelands of the west do not support a 70 percent vegetative cover, but are not necessarily high producers of sediment because of the nature of the soil, gravel pavements that have developed, and the lack of runoff-producing precipitation.

d. Livestock access in the riparian or streamside management zone should be restricted for sufficient periods to allow vegetative recovery and maintenance. Livestock exclusions are primarily important in areas where water uses to be protected include fisheries production, wildlife, primary contact recreation and human consumption.

e. Periodic stream surveys, especially in heavily used areas, are an essential part of a good rangeland resource management program. The surveys should be related to water uses to be protected and land management activities. Stream surveys are essential to evaluate the effectiveness of site-specific BMPs.

f. Soil characteristics (texture, structure, consistency, and mositure holding capacity) climate, type of vegetation, and implements used are the principle variables that determine water quality impacts of any treatment. An understanding of these variables is essential to evaluate the potential for or to minimize the water quality impacts from any rangeland mechanical treatment.

g. With severe soil disturbance resulting from many rangeland mechanical treatments, it is essential that sites be conducive to vegetation establishment with seeding after the treatment is completed. Since the life of most rangeland mechanical treatments is relatively short, it is essential to minimize water quality impacts from sediment that a desirable vegetation cover be established and maintained.

Summary and Conclusions

Water quality problems associated with grazing activities are of three basic types: (1) overgrazing that results in soil erosion, increased runoff and pollutant transport, (2) concentrated grazing activities in the streamside management zone, and (3) impacts associated with rangeland treatments. Proximity to streams, water uses, soil, vegetation and hydrologic characteristics of the area are key factors in assessing impact potential of grazing and land treatment activities.

In many instances, it is not necessary nor appropriate to apply BMPs across the board or throughout a watershed. The emphasis in selection and application of BMPs should be on recognized or potential water quality problem areas. Coordinated interdisciplinary resource planning involving State, Federal, and private rangeland managers is an effective tool for minimizing impacts from grazing animal management.

Water quality management plans should be the broad umbrella under which other types of land use planning with water quality implications fall. It is recognized that many aspects of the planning discussion are most applicable and appropriate for Federal, State, and local units of government involved in land management or planning. However, basic range conservation plans developed in water quality problem areas for individual land owners and operators should be prepared with an awareness of Federal, state, and local water quality requirements and goals. It is essential that broad scale planning such as allotment management planning of Federal land management agencies be consistent with the water quality management plan for the area.

The process of monitoring, evaluating, and upgrading specific BMPs for water quality is a continuing process. The planning and management agencies must jointly work together throughout this process to assure coming up with implementable and effective pollution control programs irrespective of land ownership. Institutional arrangements and agreements must be periodically reviewed and formally reaffirmed to facilitate this required upgrading process. Controls will usually be administered by state or local agencies on state and private land and by the Federal agencies (U.S. Forest Service and Bureau of Land Management) on Federal rangeland.

BLM - USGS Flood Routing Study in the Willow Creek Basin

Dan Muller

Willow Creek is located in northeastern Montana near Glasgow (see map). It is a tributary of the Milk River which is within the Missouri River Basin. There are 538 square miles of drainage above a USGS gauging station, located 10.6 miles upstream from the confluence of Willow Creek and the Milk River. Willow Creek is managed by Valley Resource Area within Lewistown District. Effective management is important in this watershed since public land dominates the surface area. There are small tracts of private land along segments of the main stream, and on upper tributaries. Nearly all public lands are included in existing or proposed allotment management plans.

The major landforms include wide, almost level floodplains; alluvial fans, footslopes, and terraces; and sedimentary uplands. Elevation of the USGS gauging station is 2,086 feet above sea level. The upper reaches of this basin are 2,800 feet above sea level. Average gradient of Willow Creek is low (0.1%-0.2%). A major part of Willow Creek's drainage has a south-southeast aspect and is disected by two major tributaries. Upper Willow Creek begins its course via north and south branches, then flows northeast until it reaches the Milk River.

A continental type climate is characterized by a large percentage of average total precipitation occurring, in late spring and early summer, as rain (April, May, and June). These storms are long duration, low intensity events. Thunder storms occurring between July and September are often very intense. Although winter snow storms contribute only 24% of average annual precipitation total, runoff from snow pack can be dramatic. Rapid increases of temperature, dark gray soils, and early spring rains cause snowmelt periods to be short, with high runoff peaks. Temperatures fluctuate widely with July average daily maximum being 84° F, and January average daily minimum being 0° F (National Weather Service, 1976).

Soils and vegetation of the Willow Creek basin are major factors responsible for watershed problems. The soils are shale derived (Bearpaw Shale formed during the Upper Cretaceous period), and have high runoff potential. These soil series are classified into SCS's hydrologic soil groups C or D. High percentages of clay (up to 65%) and sodium (SAR up to 14), contents in soils are responsible for slow infiltration, and relatively low permeability (BLM, 1976). Vegetative cover especially on the alluvial fans, shale outcrops, and acid shale soils will vary from near 0 to 55 percent. Cover increases on footslopes, floodplains, and upland benches. The cover consists of grasses, forbs, and low growing shrubs.

Erosion and sediment yields are high. This is evidenced by natural gully and rill erosion occurring throughout the basin. When channel bank stability is rated high, sediment loads are still very noticeable. Sediment yield studies were conducted by the BLM during 1980 field season and results are being compiled. According to collected data, sediment depths accumulated over 10 years in reservoirs often reached seven feet. Corresponding reservoir drainage areas were often less than 1 square mile. Studies show maximum sediment yields to be 1.8 to 2.5 acre-feet/square mile/year (BLM, 1979 and USGS, 1972).

For more detailed descriptions of climate, soils, vegetation, runoff, and erosion consult the Missouri Breaks Environmental Impact Statement. The brief descriptions in this paper attempt to show ideal conditions for potential problems with flooding, soil loss, and minimal forage production.

Purpose and Objective of This Study

Because of natural runoff conditions in Willow Creek Basin, the BLM funded a watershed conservation project during late 1950s and early 1960s. Construction of retention/detention reservoirs, water spreaders, and contour furrows were completed. This project was distributed evenly throughout the Willow Creek drainage. Total cost of this project was $950,000.00. This cost included construction of 243 reservoirs, four water spreader systems, and four contour furrow systems. Yearly maintenance costs are high and require large workload commitments.

A flood routing study was proposed several years ago by USGS and BLM personnel. At that time other studies for determining effects of the structures were being completed, and included forage production, soil moisture, erosion condition, and sediment yields. Runoff data was collected at three reservoirs during field seasons of 1954 - 1967. This information developed good estimates of average seasonal runoff. Since this analysis was based on inflow/outflow of three reservoirs, little consideration was given to storage structures above gauging points. With the information and data collected in Willow Creek Basin, there was still a need to observe affects of specific structures on storm runoff hydrographs.

The objective of this study is to calibrate several flood routing models on a representative water spreader system, and a small watershed with retention and detention reservoirs. This resulting model will be applied throughout the Willow Creek drainage, and reduced runoff will be estimated. Reduced runoff or decreased storm hydrograph peaks will be related to increased benefits, as a result of watershed conservation structures.

Once cost/benefit ratios are derived, watershed planning on Willow Creek Basin will be more effective. Costs for design, construction, and maintenance of structures will be analyzed against benefits from increased forage and soil moisture, and decreased runoff intensities and sediment yields.

A Brief History of Willow Creek

Historically, flooding and erosion have been documented by news media, state and Federal agencies, and private land owners. Since the Willow Creek structures were built, a 45 percent decrease in peak discharges has been estimated (USGS, 1972). The largest runoff event, since structures were built, occurred in July of 1962. A peak discharge of 12,400 cfs was recorded by USGS at their gauging station. (USGS, 1979). If this peak is a 45 percent reduction, then without conservation structures this discharge would have been significantly increased to 26,000 cfs.

Old range photos prior to construction of the conservation structures show erosion being severe. Observations from these historic photos show large concentrations of gullies and headcuts. Recent photos often show stream bank vegetation increased, and old headcutting rates slowed. Some headcuts and gullies show highly increased vegetative cover.

The Willow Creek Conservation Project had a high initial cost in 1952. This cost with todays inflationary trends would be considerably higher. Maintenance needs on watershed structures are greater than current workload capabilities and available funds. For this reason, there are no annual maintenance cost summaries available. Water spreader systems are difficult to inventory for maintenance needs due to access and large land areas.

Proposed Methods for Data Collection and Analyses

Representative watersheds were selected in May, 1980 by BLM hydrologists through coordination with USGS. A watershed located above Triple Cross Reservoir on Lone Tree Creek will be evaluated for affects of retention/ detention reservoirs. A representative water spreader system, Cactus Flat Spreaders, was selected for spreader evaluation. A third watershed located within Lone Tree drainage will be a comparison study site, since there are no manmade structures located in this watershed.

There are 40 reservoirs located above Triple Cross Reservoir, in the Lone Tree drainage area. Triple Cross Reservoir is located 12 miles from Lone Tree - Willow Creek confluence, and has a drainage area of 49 square miles. The USGS has installed three rainfall intensity gauges, with one located at Triple Cross Reservoir, one located midway up the drainage, and one in the headwater area. One recording reservoir stage gauge is located at Triple Cross Reservoir. Surveys in this watershed will include reservoir capacities/elevations; spillway and channel cross sections, and outlet pipe and head changes.

Cactus Flat Spreaders obtain their water from Wilderness Coulee which drains seven square miles. The spreaders irrigate or cover 300 acres, including a detention reservoir above the system. Wilderness Coulee is a tributary of Willow Creek near the USGS gauging station. A topographic survey of these spreaders was completed in 1980. This topographic map will be used to compute storage capacities within the spreaders. Other surveys will include channel cross sections, and outlet pipe and head changes.

Outflows from this complex spreader system are numerous. One reservoir stage gauge and three streamflow gauges were installed to monitor all outflows. There is one additional reservoir stage gauge in the upstream detention structure to monitor inflow. Two rainfall intensity gauges have been installed, one at the headwaters area of Wilderness Coulee, and another gauge is located near the spreader system.

The comparison watershed is on a tributary downstream from Triple Cross Reservoir. It has a watershed area of 1.5 square miles. The BLM has installed a recording stream gauge and rainfall intensity gauge near the mouth of this tributary. Soils and vegetation complexes are relatively homogenous throughout all study watersheds.

Data reduction and analysis will be completed by USGS after three or more significant runoff events have been monitored (target date for analysis is 1983).

Three models have been suggested to use with this study. The SCS runoff model, Corps of Engineers' HEC 1 model and SEA's HYMO model are used for flood routing. Each model has the capability of utilizing the SCS soil-cover numbers for predicting land use effects on storm runoff. Although these models have been selected for calibration at this time, there is flexibility for using other runoff models.

Three years are needed to complete the study (provided successful occurrence of storm runoff). Streamflow stations and rain gauges were installed in 1980, and will be monitored throughout the duration of the study. Survey work was initiated during 1980, and will continue through 1982. Data compilation and model development work will be accomplished during 1983. A breakdown of cost proposals by fiscal year follows: FY-81, 26,900.00; FY-82, $26,900.00; FY-83, $27,200.00. The total cost for this study is $81,000.00. Cost for USGS workloads, and equipment needs is approximately 62 percent of the total project expenditure.

Conclusion and Summary

Once costs and benefits from conservation structures are summarized, resource managers and specialists will use this information in developing a Resource Management Plan in 1984. The Willow Creek watershed, because of its runoff characteristics, vegetative cover and erosion severity will be addressed specifically within Valley Resource Area's planning development. Willow Creek has been identified as a single problem area in current MFPs and URAs.

Recommendations such as: carefully selected livestock grazing systems; identification of livestock caused erosion and vegetation problems; proper fencing, to control livestock and protect sensitive areas; revegetation of problem sites; selective road construction; and need for this flood routing study, have been made (BLM, 1976). These recommendations combined with new recommendations formulated from recent studies will be used in watershed planning, in the Willow Creek Basin.

Once the models are calibrated for this geographical area, they will be available for use in other BLM programs. Project design and layout of water facilities, involving runoff, can be improved through use of flood routing models. Other applications can be used whenever runoff figures or hydrographs are needed. Often sediment yield, water quality, and annual water production modeling are computed for a watershed using various type of runoff data for input.

Data and final reports for this study will be published during 1983 by the USGS. At that time, statistical analysis for testing several corresponding flood routing models will be available. This information will be helpful to other studies involving the models used in this study.

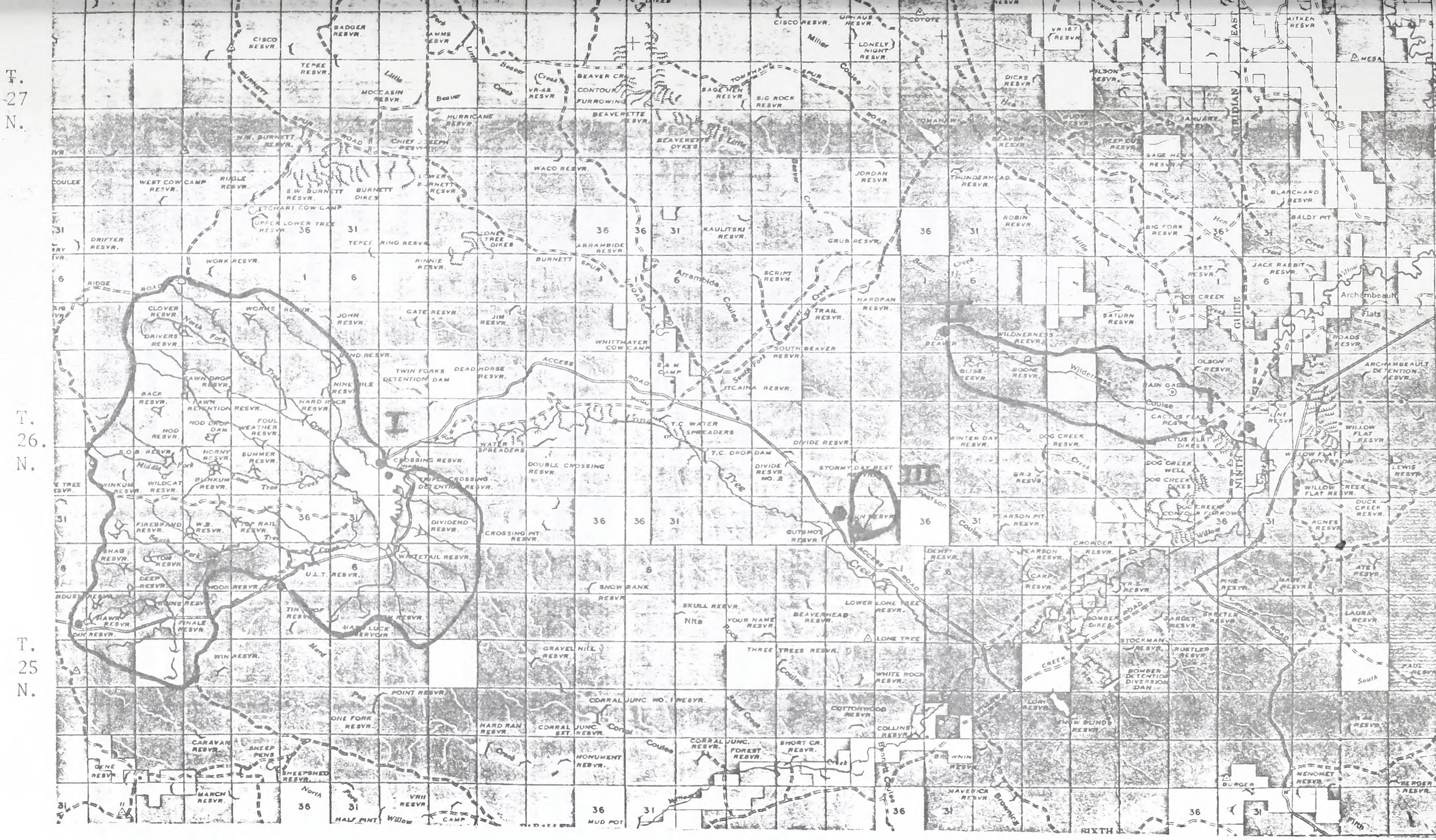
Burton, Timothy A., 1979, Inventory Report: Reservoir Sediment Survey - North Central Montana (unpublished report), U.S.D.I., Bureau of Land Management, Lewistown, Montana.

Frickel, Donald G., 1972, Hydrology and Effects of Conservation Structures, Willow Creek Basin, Valley County, Montana, 1954-68, U.S.D.I., U.S. Geologic Survey, Denver, Colorado.

Soiseth, Ron, 1976, Willow Creek Basin - Present Situation (Unpublished), U.S.D.I. Bureau of Land Management, Malta, Montana.

U.S. Department of Commerce, 1976, Computer Output Summary of Climate in Montana Glasgow Airport Weather Station, Asheville, N.C.

U.S. Department of Interior, 1979, Water Resources Data for Montana, U.S. Geologic Survey, Helena, Montana.



WILLOW CREEK BASIN
South Valley County, Montana
I Lonetree Creek above Triple Cross Reservoir
II Wilderness Coulee above Cactus Flat Water Spreaders
III Tributary to Lonetree Creek (without conservation structures)

- ⬢ Rainfall intensity gauge
- ● Reservoir stage gauge
- ▲ Streamflow stage gauge

USGS/BLM Scientist and Engineer Exchange Program

Rich Herbert, Hydrologist
Phone: FTS 234-3458

The purposes of the exchange program are to:

1. Help the Department of the Interior meet its energy and minerals objectives through greater understanding of the interrelationships of the two bureaus' roles by the scientists and engineers of both bureaus.

2. Provide developmental opportunities to scientists and engineers in both bureaus.

I applied through Washington Office Announcement No. 79-81. It took almost a full year from the time I first started looking into the program until I actually got the job. The best approach is to contact the USGS office that you are interested in working with and determining if they would be interested in having you work on any particular project or problem. The next step is to fill out your SF 171 and the other forms contained in Announcement WO 79-81 and send them to your State Director with a letter describing your intentions and why you are applying for the program.

Unfortunately, there are some problems created whenever someone is accepted into this program. The way it is set up, the office you are working in at the time you apply continues to pay your wages and holds your position for the entire 2-year period of the exchange. The USGS pays your travel and per diem expenses. This imposes a rather large hardship on the loosing office. If I were in a position making recommendations for changes in the program, I would suggest that one or two positions be established in DSC or the Washington Office to accommodate people who are interested in the program. With positions designated specifically for the exchange program, there would be no burden placed on any single office and I think the program would be much more readily accepted by management in the field. As it is now, managers are extremely reluctant to approve any applications for the program.

My curriculum includes working on three major coal and oil shale hydrology projects during the first year:

1. Developing stream geometry relationships for use in rehabilitation of coal and oil shale areas.

2. Modeling several EMRIA watersheds.

3. Monitoring ground water and Lysemeters in the EMRIA study sites.

So far things have gone extremely well. I have learned a great deal and I could not have made a better choice for my career development.

BLM RAINFALL SIMULATION STUDIES AND EROSION ASPECTS

by
Eric B. Janes, Project Studies Chief,
D-450, Denver Service Center

I. INTRODUCTION

After having conducted rainfall simulation investigations of the hydrologic effects of livestock use since the spring of 1978, the Bureau of Land Management (BLM) is taking a closer look at the advantages and disadvantages of simulation as a research and management tool. The original management need at which the formation of the DSC Rainfall Simulation Project was aimed was the requirement for site-specific initial infiltration values, impacted infiltration rates and sediment discharge data in connection with a Bureauwide desire to improve range management activity planning and EIS quantification. Testing of widely-used techniques such as the Universal Soil Loss Equation (USLE), Pacific Southwest Interagency Committee (PSAIC) method, and Soil Surface Factor (SSF) as related to plot soil loss was planned.

II. PRESENT SITUATION

To date, the project has completed study sites and reporting in the Riverside (CA), Green Mountain (WY), Prairie Potholes (MT), and Phoenix (AZ) areas. We are in the middle of a 1980-81 effort near Naturita, Colorado for the Montrose District.

As could be expected from any pioneering effort, numerous problems have been encountered after the first three field seasons. The first general area of difficulty for our effort involves having attempted to do too much over too extensive (multi-state) an area. Logistical problems, already inherently complex by virtue of the simulator design and size, were thus compounded. Secondly, the number of sites needing to be visited by the project crew precluded the necessary simplification of field findings into readily applicable interpretive products. Problems exist with some of the relationships and methodologies presented to the Districts in the rainfall simulation study area reports, and possible field office application without adequate understanding of limitations and interpretations involved.

Paper presented February 5, 1981 in Jackson Hole, Wyoming at the Northern Rocky Mountain Regional Soil, Water, and Air Workshop.

The data analysis procedure for soil loss relationships typically consisted of stepwise multiple regressions using total run soil loss as a function of several plot vegetation, soils, and topographic characteristics. Unfortunately, the small number of simulator plots were generally scattered over several different soil series, plant communities, and combinations of grazing use characteristics.

The analysis for the Green Mountain study area in west-central Wyoming resulted in a significant regression of total run soil loss as a function of total runoff and percent slope ($R^2 = .85$). This was after removing range condition and percent litter from the analysis, which were both positively correlated to total run soil loss.

The USLE was used on an event basis to evaluate its predictive ability on these particular simulation plots, having an average slope length of 65 feet. The USLE consistently overpredicted the measured plot soil loss on dry and wet antecedent moisture conditions, often by several hundred percent. The PSIAC method and SSF rating were not evaluated on the Green Mountain study area.

The Prairie Potholes study area of northeastern Montana was intended to be used to evaluate season-long and rest-rotation grazing use as effects the hydrologic response, but not enough simulation runs were made to allow a sound statistical analysis for these systems.

Multiple regressions on plot characteristics resulted in a regression of total soil loss as a function of plot curve number, percent basal clubmoss, and the USLE soil erodibility factor, K ($R^2 = .40$). A second soil association resulted in the regression containing percent foliar bare and percent antecedent soil moisture as the significant independent variables ($R^2 = .81$).

Comparisons of measured soil loss on Prairie Potholes to USLE, PSIAC, and SSF again showed USLE to consistently overpredict the soil loss on an event basis. Nevertheless, for all plots lumped, the USLE estimate was most highly correlated to measured values (R .95), with PSIAC second (R .75), and SSF last (R .58).

The analyses to date from the BLM Rainfall Simulation Project have typically raised more questions than they have answered. A major problem with the large simulator system is the logistics of acquiring an adequate sample size while maintaining consistency with respect to some of the base resource characteristics such as soils and plant communities. The regressions for soil loss have not been consistent as far as the significant independent variables, and correlation coefficients for variables often fluctuate widely between study areas.

Typically, several of the variables, including soil series, range site, grazing intensity, range condition, season of livestock use, and class of livestock may be changing from plot to plot. The objectives of evaluating hydrologic response differences due to each of these variables has caused the limited resources of the Rainfall Simulation Project to be stretched to the point of not being able to adequately understand response differences due to any of them.

Since the end of the 1980 field season a rescoping of BLM's Rainfall Simulation Project has been underway. While not yet complete, and though still considering Bureauwide and non-Bureau input, the framework being developed is perceivable as a sharp shift in the thrust of the past several years.

"SAVAL RANCH RESEARCH AND EVALUATION PROGRAM"

by Eric B. Janes, Project Studies Chief
DSC, Division of Special Studies

In 1978, a research and evaluation program was initiated on the Saval Ranch in northeastern Nevada. This working ranch, on land typical of thousands of acres of rangeland in the Intermountain West, is an ideal laboratory for field studies.

In an interdisciplinary, cooperative effort, personnel are gathering information necessary to design a multi-resource rangeland management system. Knowledge gained will also be used to prepare sound grazing management plans and environmental assessments and to provide monitoring and research data to evaluate the effects of resource management actions.

OBJECTIVE

The specific objective of this program is to evaluate the effects of livestock grazing systems and range improvement practices on vegetation, livestock production, fish and wildlife and their habitats, watershed values, water quality, and other resource values.

The objective is being approached in the following ways:

- Inventory the basic resources in sufficient detail to guide the development of sound rangeland management and improvement practices.
- Design and implement a grazing management system and necessary range improvements based on inventory information, livestock requirements, and multiple-use needs.
- Establish monitoring systems of sufficient precision to detect changes in resources and outputs.
- Establish a procedure to evaluate the accrued socio-economic benefits and benefit/cost ratio, and to determine the costs of implementing a complete management system.

STUDY AREA

The Saval Ranch is located about 50 miles north of Elko, Nevada at an elevation of about 6,300 feet. The ranch and grazing allotment contain about 11,000 acres of private land, 17,000 acres managed by the Bureau of Land Management, and 17,000 acres managed by the Forest Service.

Presented February 5, 1981, in Jackson, Wyoming at the Northern Rocky Mountain BLM Soil, Water, and Air Workshop.

The climate of the area is semiarid with cold, moist winters and warm, dry summers. Average annual air temperatures range from about 49 degrees Fahrenheit in the valley to less than 42 degrees in the mountains. Annual precipitation averages about 9 inches in the valley and 18 inches in the mountains.

Flood plain soils are very deep, dark-colored, poorly drained, and calcareous. Soils on the terraces occur on sloping land, are dark-colored, very slowly permeable to water, and have hardpans. Upland soils overlay flint-like quartz and granite-like bedrock, are dark-colored, moderately to slowly permeable to water, and occur on steep slopes.

Natural vegetation is typical of the northern part of the Intermountain Region. Common shrubs include sagebrush, rabbitbrush, bitterbrush, snowberry, serviceberry, and chokecherry. Native grasses include needlegrass, bluegrass, squirreltail, wheatgrass, fescue, bromegrass, and wildrye. In addition, there are about 4,000 acres of introduced crested wheatgrass. The most abundant broadleaf species are balsamroot, phlox, aster, lupine, milkvetch, hawksbeard, groundsel, wyethia, and wild buckwheat. Streamside vegetation is characterized by aspen, willow, and stringer meadow habitats.

Seven streams arise on land managed by the Forest Service and bisect some or all of the study area. Gance, Mahala, and California Creeks flow most of the year. Hill, Jim, Sheep, and Stump Creeks run water mostly during snowmelt. In general, headwaters of Jim, Sheep, Stump, and California Creeks are stable. The headwaters of Mahala and Gance Creeks are less stable and channel cutting is active in some places.

Mule deer and sage grouse are the major game species, although 16 other game species occur. The "threatened" Lahontan cutthroat trout occurs in Gance, Mahala, and California Creeks. Other fish species are sculpin, sucker, shiner, and dace. Nongame animals are represented by 81 species--21 mammals, 53 birds, and 7 reptiles.

ACCOMPLISHMENTS

The first three years of this program have been devoted to obtaining the inventory of basic resources to provide baseline data for environmental assessments, management plans, and for future studies.

The following aspects of the program have been accomplished:

- Soil Inventory
- Vegetation Inventory
- Range Site Descriptions
- Inventory of Game and Nongame Species
- Descriptions of Stream Channels and Water Quality

* Inventory of Aquatic Habitat
* Inventory of Fish Populations
* Inventory of Macro-Invertebrates
* Climatic Network

THE FUTURE

Although a great deal has been accomplished, much remains to be done. The monitoring and research phases of the study will start in 1981 when livestock grazing under the management plan begins. Studies will be conducted in accordance with project proposals developed by resource and livestock specialists, and approved by a steering committee. The response of the soil, water, vegetation, livestock, wildlife, and archaeological resources to various management and improvement practices will be measured. An economic study will analyze the trade-off relationships between livestock management and other multiple uses on public lands and the effects of land use decisions on private property values, ranch income, rancher capital, and land use practices. The study will also estimate benefits and costs to user groups, management agencies, and the public.

STEERING COMMITTEE

A steering committee is responsible for the development of overall plans and actions needed to accomplish the study. This committee of technical representatives from many agencies and organizations determines inventory levels, management practices, improvements, monitoring systems, research needs, and socio-economic evaluations. The committee also works with land managers to prepare coordinated rangeland management plans and environmental assessments for the study area.

ADDITIONAL INFORMATION

For additional information on the Saval Ranch Research and Evaluation Program contact:

COOPERATORS

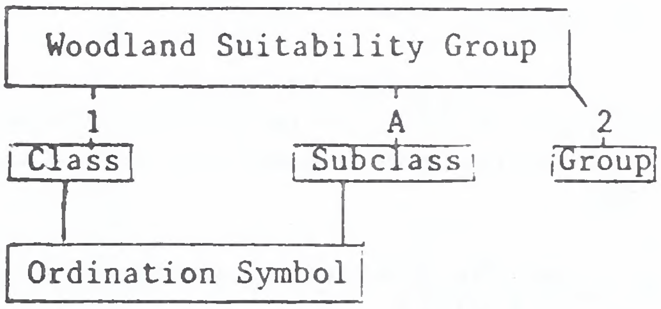
Bureau of Land Management
Nevada Cattlemen's Association
Nevada Department of Wildlife
Saval Ranching Co., Inc.
Science and Education Administration
Soil Conservation Service
University of Nevada-Reno, College of Agriculture
USDA Forest Service, Humboldt National Forest

Vern Webb
Coeur d'Alene District

§537.20 Purpose of ordination.

(a) The ordination system is a uniform system of labeling individual soils or groups of like soils to determine the productivity potential and the principal soil properties in relation to any hazards or limitations of that soil. The ordination system has three levels: Class, (see §537.23); subclass, (see §537.22); and group (see §537.23). The three-part symbol is called a woodland suitability group. The class and subclass symbols are called ordination symbols. The system provides uniformity in grouping soils for interpretation.

Example:



(b) The ordination of soils through the class and subclass is required; determining the group is optional. Each state decides whether to present woodland interpretations in Section II of the technical guides by woodland suitability groups or by individual soils. When woodland groups are used, the information is presented by the three-symbol ordination system (woodland suitability group). When presented by individual soils, only class and subclass need to be indicated for each soil.

§537.21 Productivity class.

(a) Class symbol meaning. The first element in ordination is a number that denotes potential productivity in terms of cubic meters of wood per hectare per year for an indicator tree species. Potential productivity is based on site index. A mean annual increment of one m^3/ha (cubic meter per hectare) equals 14.3 ft.^{3}/ac. (14.3 cubic feet per acre). For quick conversion a factor of 15 may be used for example:

1 means 1 cubic meter per hectare per year (14.3 ft.^{3}/ac.)
2 means 2 cubic meters per hectare per year (28.6 ft.^{3}/ac)
10 means 10 cubic meters per hectare per year (143 ft.^{3}/ac.)

(b) Indicator species. The indicator species is the species that is common in the area and is generally the most productive on soil. It is the species that determines the ordination class. The TSC forester approves the indicator species selected for each soil. The indicator species is always underlined. Productivity class is also calculated for other important common trees on the soil.

(c) Yield assumptions. The yield in cubic meters is calculated at the age of culmination of mean annual increment for fully stocked natural stands (unmanaged except for protection) as given in standard normal yield tables. An exception to this might be made for a species grown primarily in plantations where the use of measured plantation yield seems more logical. Yield is the total wood produced in the boles of the trees to the smallest top diameter given in tables. The TSC forester designates the yield tables to be used in calculating cubic volumes. Culmination of mean annual increment (CMAI) is the volume at the point of the highest yearly growth.

(d) Converting site index to yield. Site index is converted to yields by using yield tables to establish productivity classes. The TSC forester develops conversion values for important species in the states served by the TSC.

(e) Calculating the production class symbol used in ordination. The procedure is as follows:

(1) Determine the cubic foot volume for each site index at CMAI from appropriate yield table. See §537.94 (1) through (10).

(2) Divide each cubic foot volume by 14.3 to determine cubic meters per hectare. Carry figure out to two decimal points and round off figure.

(3) Group the ranges of m^3/ha.

Example: 5.5-6.5 m^3/ha equals productivity class 6. The corresponding range of site indices is 62-70.

Tables 537-6 and 537-7 are examples of this calculation. Source: U.S. Dept. Agric., For. Serv., 1929. Volume, yield, and stand tables for second-growth southern pines. Misc. Pub. No. 50. Table 40.

Table 537-6.--Loblolly pine [1]

Site index	Ft^3	M^3/ha	Productivity class
60	76	5.3	5
61	78	5.4	
62	79	5.5	6
63	81	5.7	
64	83	5.8	
65	85	5.9	
66	86	6	
67	88	6.2	
68	90	6.3	
69	91	6.4	
70	93	6.5	
71	95	6.6	7
72	96	6.7	
73	98	6.8	
74	100	7	
75	101	7.1	
76	103	7.2	
77	105	7.3	
78	107	7.5	8
79	108	7.6	
80	110	7.7	
81	112	7.8	
82	114	8	
83	116	8.1	
84	118	8.2	
85	120	8.4	
86	123	8.6	9
87	125	8.7	
88	127	8.9	
89	129	9	
90	131	9.2	
91	133	9.3	
92	136	9.5	10
93	138	9.6	
94	140	9.8	
95	142	9.9	
96	145	10.1	
97	147	10.3	
98	149	10.4	
99	152	10.6	11
100	154	10.8	
101	156	10.9	
102	159	11.1	
103	161	11.3	
104	163	11.4	
105	166	11.6	12
106	168	11.8	
107	170	11.9	
108	172	12	
109	175	12.2	
110	177	12.4	
111	180	12.6	13
112	182	12.7	
113	185	12.9	
114	188	13.2	
115	191	13.4	
116	193	13.7	14
118	199	13.9	
119	201	14.1	
120	204	14.3	

---

[1] Round off to the nearest whole number. If the number preceding a .5 is odd, round upward; if number is even, round downward, such as 9.5 = 10, 12.5 = 12.

Table 537-7.--Productivity classes.for loblolly pines.

Productivity class	Mean site index at 50 years	Range of site index	Cubic volume yield per m^3ha/yr	Cubic volume yield per ft^3/ac/yr
5		62		
6	66	62-70	6	86
7	74	71-77	7	100
8	82	78-85	8	114
9	89	86-91	9	129
10	95	92-98	10	143
11	101	99-104	11	157
12	108	105-110	12	172
13	113	111-115	13	186
14		116 +		

§537.22 Ordination subclass.

(a) Subclass symbol. The second element or subclass is indicated by a capital letter, which indicates certain soil or physiographic characteristics that contribute to important hazards or limitations in management.

(b) Subclass definitions and implications.

Subclass X (stoniness or rockiness). Soils having restrictions or limitations for forest land use or management because of stones or rocks.

Subclass W (excessive wetness). Soils in which excessive water, either seasonally or year round, causes significant limitations for forest land use or management. These soils have restricted drainage, high water tables, or overflow hazards that adversely affect either stand development or management.

Subclass T (toxic substances). Soils that have within the rooting zone excessive alkalinity, acidity, sodium salts, or other toxic substances that limit or impede development of desirable tree species.

Subclass D (restricted rooting depth). Soils with restrictions or limitations for forest land use or management because of rooting depths. Example shallow soil that are underlain by hard rock, hardpan, or other layers in the soil that restrict roots.

Subclass C (clayey soils). Soils having restrictions or limitations for forest land use or management because of the kind or amount of clay in the upper portion of the soil profile.

Subclass S (sandy soils). Dry sandy soils with little or no textural B horizons and having moderate to severe restrictions or limitations for forest land use or management. These soils impose equipment limitations, have low moisture holding capacity, and normally are low in available plant nutrients.

Subclass F (fragmental or skeletal soils). Soils with restrictions or limitations for forest land use or management because the profile reveals large amounts of coarse fragments that are more than 2 mm and less than 10 inches. This subclass includes flaggy soils.

Subclass R (relief or slope steepness). Soils with restrictions or limitations for forest land use or management only because of steepness of slope. R is used only when there are no other soil characteristics causing moderate or severe limitations.

Subclass A (no limitations or slight limitations). Soils with no significant restrictions or limitations for forest land use or management.

(c) Multiple limitations. Some kinds of soil may have more than one limiting characteristic. Priority in placing each kind of soil into a subclass must be in the order in which the subclass characteristics are listed above. Plant competition and special considerations are not to be used to determine subclass.

§537.23 Group.

A group symbol, represented by an Arabic number, may be used to complete the ordination symbol. Procedures are established by TSC's through the TSC forester and head of the soils staff. No national meaning is attached to the group number. Each TSC may adopt whatever system is most suitable. The group number can be used to present soil mapping units that respond similarly. Thus a woodland suitability group is made up of kinds of soils that are capable of producing similar kinds of trees and understory vegetation, that need similar management to produce these crops when the existing vegetation is similar, and that have about the same potential productivity.

§537.24 Ordination rules.

(a) Format. The ordination symbols give clues to productivity and to soil-related problems if any. Productivity is expressed as a one- or two-digit Arabic number followed by a capital letter that alerts the user to important soil or physiographic characteristics related to limitations, hazards or problems in management. Subclass elements are selected according to the most limiting factor.

(b) Slight limitations. If slight limitations are present, the letter "A" is used; for example, 8A means a potential productivity of 8 cubic meters per hectare per year with slight or no soil-related limitations. 2A means a potential productivity of 2 cubic meters per hectare per year with slight or no soil-related limitations.

(c) Moderate and severe limitations. If a soil has moderate or severe limitations, a capital letter following the productivity number indicates the soil or physiographic characteristic that best describes the most severe limitation. Designate subclasses by capital letters X, W, T, D, C, S, F, or R. For example, 7X means a potential productivity of 7 cubic meters per hectare per year with moderate or severe limitations due to stoniness or rockiness (X). 14S describes a potential productivity of 14 cubic meters per hectare per year with moderate or severe limitations due to sandiness (S).

(d) Uniformity of subclass designations. For soils with multiple soil or physiographic characteristics, the TSC forester and correlator for soil interpretations are to give guidance to the state staff to ensure uniformity in selecting a subclass element.

(e) Group symbol. To serve local and regional needs soils can be grouped within woodland suitability subclasses to get uniformity among the subclass items rated. The smallest number of groups possible is desirable so long as information significant to soil use and management is not lost when providing the information by groups of soils. Groups are numbered with Arabic numerals starting with 1. These numbers represent the third element of a symbol showing the complete ordination of each kind of soil, such as 9A1, 9A2, 7A1, 7A2, 7A3, 7W1, 6S1, and 4F1

§537.97 Table E, Woodland Management and Productivity, of soil survey reports.

WOODLAND MANAGEMENT AND PRODUCTIVITY

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Wind-throw hazard	~~Important~~ Common trees	Site index	Productivity Class	
Cecil: CeB, CeC, CeD---	8A	Slight	Slight	Slight	Slight	Eastern white pine	80	10	Loblolly pine, yellow-poplar.
						Loblolly pine ----	80	8	
						Shortlead pine ---	67	7	
						Virginia pine ----	73	8	
						Black oak --------	66	3	
						Northern read oak-	82	4	
						Post oak ---------	65	3	
						Scarlet oak ------	80	4	
Mecklenburg: MaC2, MnD2 ----	6C	Moderate	Moderate	Moderate	Slight	Loblolly pine ----	66	6	Loblolly pine, Virginia pine, eastern redcedar.
						Shortleaf pine ---	59	6	
Pacolet: PfE -----------	7R	Moderate	Moderate	Slight	Slight	Northern red oak-	79	4	Loblolly pine, shortleaf pine Virginia pine, yellow-poplar.
						Southern red oak-	74	4	
						Sweetgun --------	82	-	
						Virginia pine ---	78	8	
						Loblolly pine ---	72	7	
						Shortleaf pine --	70	8	
						Yellow-poplar ---	86	6	
PgE2------------	7C	Severe	Severe	Severe	Slight	Loblolly pine ---	72	7	Loblolly pine, shortleaf pine
						Shortleaf pine --	60	6	
IpbC-----------	7A	Slight	Slight	Slight	Slight	Loblolly pine ---	72	7	Loblolly pine, yellow-poplar.
						Shortleaf pine --	70	8	
						Yellow-poplar ---	86	-	
						Northern red oak-	79	4	
						Southern red oak-	74	4	
						Sweetgum --------	82	-	
						Virginia pine ---	78	8	
Toccoa: To -------------	9A	Slight	Slight	Slight	Slight	Loblolly pine ---	90	9	Loblolly pine, yellow-poplar, American sycamore cherrybark oak
						Yellow-poplar ---	107	8	
						Sweetgum --------	100	-	
						Southern red oak-	---	-	
Wickham: WhB-------------	8A	Slight	Slight	Slight	Slight	Loblolly pine --	82	8	Loblolly pine, yellow-poplar, sweetgum.
						Shortleaf pine -	72	8	
						Yellow-poplar --	100	7	
						Southern red oak	80	4	

list in order of abundance

(The automated construction of this table will be made available at a later date.)

Potential Rating.

SOIL LIMITATION RATING--FOR NATIVE RANGE

PROPERTY	LIMITS			RESTRICTIVE FEATURES
	SLIGHT	MODERATE	SEVERE	
FRACTION MORE THAN 3 IN (WT PCT)(0-40")	LESS THAN 25	25-50	MORE THAN 50	LARGE STONES
DEPTH TO HIGH[1/] WATER TABLE (FT) (GROWING SEASON)	MORE THAN 3.5 ---	1.5-3.5 ---	LESS THAN 1.5 +	WETNESS OR PONDING
AVAILABLE WATER CAPACITY (IN) (0-40")	MORE THAN 4	2-4	LESS THAN 2	DROUGHTY
USDA TEXTURE (SURFACE LAYER)	---	SC,SIC,C		SLOW INTAKE
WIND ERODIBILITY GROUP	---	1,2	---	SOIL BLOWING
PERMEABILITY (IN/HR)(0-60")	---	LESS THAN 0.06	---	PERCS SLOWLY
DEPTH TO BEDROCK (IN)	MORE THAN 20	10-20	LESS THAN 10	DEPTH TO ROCK
DEPTH TO CEMENTED PAN (IN)	MORE THAN 20	10-20	LESS THAN 10	CEMENTED PAN
FRAGIPAN (GREAT GROUP)	---	ALL FRAGIPAN	---	ROOTING DEPTH
SLOPES (%)	LESS THAN 15	15-30	MORE THAN 30	SLOPE
FLOODING	NONE PROTECTED	COMMON		FLOODS
MOISTURE REGIME (PE)	MORE THAN 54	34-54	LESS THAN 34	
SODIUM ADSORPTION RATIO (GREAT GROUP)	<5 ---	5-12 ---	MORE THAN 12 (NATRIC, HALIC)	EXCESS SODIUM SLOW-INTAKE

	LIMITS			RESTRICTIVE
PROPERTY	SLIGHT	MODERATE	SEVERE	FEATURES
SALINITY (mmhos/cm)	<8 ---	8-16 ~~12-18~~	>16 MORE THAN ~~18~~	EXCESS SALT
SOIL REACTION (pH)	---	---	LESS THAN 4.5	TOO ACID
(SURFACE LAYER)	---	---	MORE THEN ~~8.5~~ 8.4	TOO ALKALINE

SOIL LIMITATION FOR WOODLAND

PROPERTY	LIMITS			RESTRICTI FEATURES
	SLIGHT	MODERATE	SEVERE	
FRACTION MORE THAN 3 INCHES (WT PCT)(0-40")	---	CLASS 2	CLASS 3,4	LARGE STONES
WATER TABLE (DEPTH LESS THAN 15")	MORE THAN 2 MO.	2 to 6 MO.[1] (AQUIC)	MORE THAN 6 MO.[2]	WETNESS
AVAILABLE WATER CAPACITY (IN) (0-60")	MORE THAN 6	4-6	LESS THAN 4	DROUGHTY
USDA TEXTURE (SURFACE LAYER)	LOAMY ---	SANDY CLAYEY	--- ---	SANDY CLAYEY
SOIL DEPTH (IN)	MORE THAN 20	10-20	LESS THAN 10	ROOTING DEPTH
SLOPE (%)	0-15	15-25	MORE THAN 25	SLOPE
EROSION FACTOR (K) SURFACE LAYER	.43 OR LESS	MORE THAN .43	GULLIED	ERODES EASILY
FLOODING	NONE RARE	OCCASIONAL	FREQUENT	FLOODS
SODIUM ADSORPTION RATIO	<5 ---	5-12 ---	MORE THAN 12 (NATRIC,HALIC)	EXCESS SODIUM
SALINITY (mmhos/cm)	LESS THAN 4	4-8	MORE THAN 8	EXCESS SALT

---

[1] Most aquic subgroups

[2] Most aqu suborders

§533.20 General.

Soil scientists have been assigned leadership for seeing that engineering interpretations are made and for completing the engineering sections of soil survey reports and other forms or documents in connection with the National Cooperative Soil Survey. These interpretations, reports, and narrative sections are to be made by or with the assistance of technical staff personnel.

§533.21 Scope.

(a) This policy establishes the role of engineers and engineering geologists in soil survey activities.

(b) The procedures, guides, and policy relating to soil survey work are in Titles 31 through 35.

§533.22 Engineering responsibilities.

(a) Engineers and engineering geologists are to assist in soil survey engineering interpretations. They are to participate fully in decisions on:

(1) Whether engineering interpretations are to be made for a given use.

(2) Criteria and guides for making soil engineering interpretations for specific uses.

(3) The quality of soil engineering interpretations for published soil surveys, special reports, or special planning efforts.

(4) The method of presentation of data dealing with interpretations and narrative reports on engineering uses of soil.

(5) Training of soil scientists and engineers to make engineering interpretations.

(b) Engineers and engineering geologists are to participate in making soil potential ratings. They are to assist in determining realistic corrective measures, costs, and continuing limitations for agricultural uses that require engineering practices. For nonagricultural uses, qualified experts from outside SCS are to participate in determining corrective measures, costs, and continuing limitations with the acceptance of SCS engineers. Engineers are to determine if adequate data are being used to determine soil potential ratings. If certain soils are not normally used for the purpose being rated, the outside experts may need to do more investigation and engineering testing to determine the types of corrective measures that are appropriate. SCS engineers and geologists are to act as advisors to personnel responsible for providing leadership in making soil potential ratings. In this advisory capacity, they are to assist in the work, make recommendations, and point out deficiencies or incorrect procedures.

(c) National Office personnel from Engineering and Soils are to work jointly to develop guides and criteria for soil survey work that requires engineering interpretations. All engineering interpretation work for soil surveys is to be prepared in accordance with established guides and criteria.

(d) The head of the TSC engineering staff is responsible for engineering support to soil survey at the TSC. He or she is to work closely with the soils staff to see that the best combination of soil science and engineering is used in making and reviewing interpretations.

(e) The state conservation engineer is responsible for providing assistance in engineering interpretation work for soil survey activities in the state and is to work closely with the state soil scientist. This responsibility may be delegated to a staff engineer who has been assigned leadership in soil mechanics or to the engineering geologist. A qualified area engineer or project engineer located near a soil survey party is to be assigned to work with the soil survey party leader or soil scientist who is making engineering interpretations.

(f) Engineers and geologists are expected to be informed on the development and use of engineering interpretations for soil surveys. Engineering training programs are to include appropriate instruction.

D. Anderson - SCS

Soils Resource Information System (SRIS) Introduction

In an effort to address soils information problems, the Colorado State University Department of Agronomy and the Laboratory for Information Science in Agriculture, both of the College of Agricultural Sciences, have initiated a joint project with the USDA/Soil Conservation Service (SCS).

The goals of this project are to determine the necessary components, structure and feasibility of a comprehensive, user oriented Soils Resource Information System (SRIS) and to design and implement an SRIS according to these determinants.

Previous work accomplished in this cooperative agreement included the development of a Pilot Soils Resource Information System. The major objectives of this Pilot were to demonstrate to soils information users the capabilities and features of a full scale SRIS and to experiment and evaluate SRIS design alternatives.

In the present phase, efforts were concentrated primarily on establishing an operational SRIS Prototype. A prototype system differs from a pilot system in that a prototype system is intended for intensive use and evaluation on a limited basis. A pilot system is used primarily for demonstration.

The SRIS Prototype consists of available Map Unit data for the Arkansas Valley in Southeastern Colorado and of Plant and Range data for the State of Colorado. In addition, an initial attempt has been made to provide more descriptive soils information for a non-technical soils information user.

Current SRIS Components

The present phase of SRIS development consists primarily of four components. Two of these components—the Map Unit portion and the Plant and Range Site portion—are in the prototype stage, intended for intensive use and evaluation. The other two components—the Management portion and the Database Codes portion—are in their initial development, or pilot stage, and are intended primarily for demonstration purposes. Brief descriptions of each component follow:

1. Soil Map Unit component: consists of attribute information for individual soil types. This component is an expansion of the work done in the SRIS Pilot. The source of the work is the SCS Soil Survey Reports.

2. Plant and Range component: consists of potential plant community data and specific data for each Range Site in Colorado. The source of the Range Site data is the Soil Conservation Service's Range Site Descriptions. The source of some of the Plant data is the Plant Information Network, Colorado State University.

3. Management component: consists of textual descriptions of specific land management practices and management alternatives identified as being most applicable to a specific soil and specific climatic conditions.

4. Database Codes component: consists of lists of codes used for coded items in SRIS and their most commonly accepted description.

SRIS conceptually contains three additional components--Soils-5, Pedon, and Climatology. Soils-5, Pedon, and Climatology are in the early pilot phase of development. The following is a brief explanation of each of these data sources:

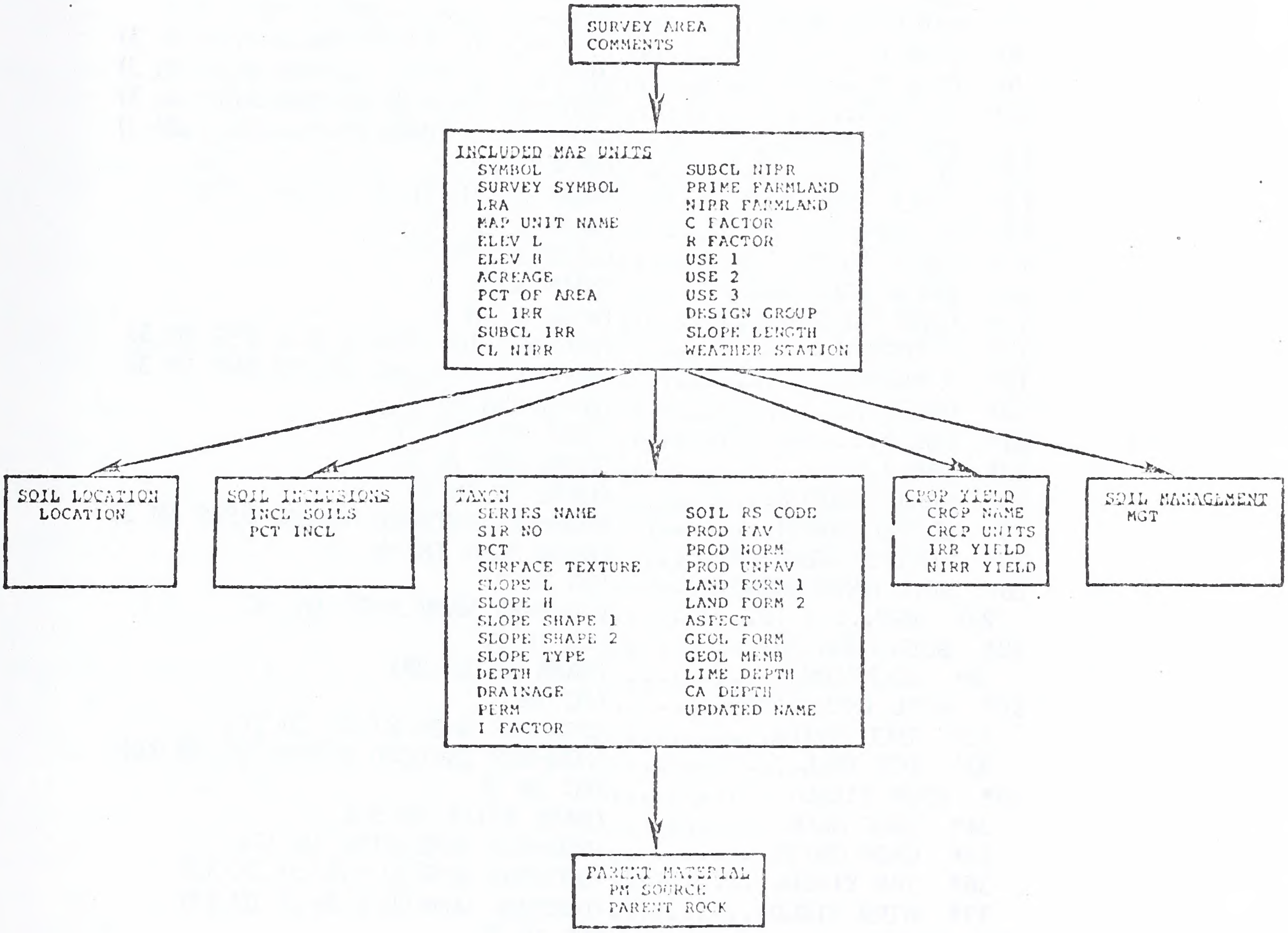
1. Soil Interpretation Records (SCS Soils-5) - These records provide information concerning the engineering properties of soils and interpretations concerning limitation of soils for various uses.

2. Soil Characterization Data (SCS National Pedon Data System) - The Pedon Data System is designed to store and retrieve summaries of pedon sites. This horizon-by-horizon description includes chemical, physical, and manipulative laboratory tests on selected horizon samples.

3. Climatology Data - This data includes monthly climatological summaries for the National Weather Service Reporting Station that represents the climatic conditions of each individual soil map unit.

No additional work was performed on these components during 1980. However, work on Soils-5 and Pedon is scheduled for 1981.

Soil Map Unit Structure Diagram



Soil Map Unit Descriptor Directory

The following listing illustrates the layout of data identifiers in the Soil Map Unit component of SRIS and their relationships to each other.

```
1000*  MAP UNIT INFORMATION.......(RG)
     1*  SURVEY AREA..............(NAME XXX IN 1000)
     2*  COMMENTS.................(NON-KEY TEXT X(80) IN 1000)
     3*  INCLUDED MAP UNITS.......(RG IN 1000)
       4*  SYMBOL.................(NAME X(5) IN 3)
       5*  SURVEY SYMBOL..........(NAME X(8) IN 3)
       6*  LRA....................(NAME XXXX IN 3)
       7*  MAP UNIT NAME..........(NON-KEY NAME X(35) IN 3)
       8*  ELEV L.................(NON-KEY INTEGER NUMBER 9(5) IN 3)
       9*  ELEV H.................(NON-KEY INTEGER NUMBER 9(5) IN 3)
      10*  ACREAGE................(NON-KEY INTEGER NUMBER 9(6) IN 3)
      11*  PCT OF AREA............(NON-KEY DECIMAL NUMBER 99.9 IN 3)
      12*  CL IRR.................(NAME X IN 3)
      13*  SUBCL IRR..............(NAME XX IN 3)
      14*  CL NIRR................(NAME X IN 3)
      15*  SUBCL NIRR.............(NAME XX IN 3)
      16*  PRIME FARMLAND.........(NAME X IN 3)
      17*  NIRR FARMLAND..........(NAME X IN 3)
      18*  C FACTOR...............(NON-KEY INTEGER NUMBER 999 IN 3)
      19*  R FACTOR...............(NON-KEY INTEGER NUMBER 999 IN 3)
      20*  USE 1..................(NAME XXX IN 3)
      21*  USE 2..................(NAME XXX IN 3)
      22*  USE 3..................(NAME XXX IN 3)
      23*  DESIGN GROUP...........(NAME XX IN 3)
      24*  SLOPE LENGTH...........(NON-KEY INTEGER NUMBER 9999 IN 3)
      25*  WEATHER STATION........(NAME XXXX IN 3)
      26*  SOIL MANAGEMENT........(RG IN 3)
        27*  MGT..................(NON-KEY NAME X(6) IN 26)
      28*  SOIL LOCATION..........(RG IN 3)
        29*  LOCATION.............(NAME XX IN 28)
      30*  SOIL INCLUSIONS........(RG IN 3)
        31*  INCL SOILS...........(NON-KEY NAME X(15) IN 30)
        32*  PCT INCL.............(NON-KEY INTEGER NUMBER 99 IN 30)
      33*  CROP YIELD.............(RG IN 3)
        34*  CROP NAME............(NAME X(15) IN 33)
        35*  CROP UNITS...........(NON-KEY NAME X(9) IN 33)
        36*  IRR YIELD............(DECIMAL NUMBER 9(5).9 IN 33)
        37*  NIRR YIELD...........(DECIMAL NUMBER 9(5).9 IN 33)
      38*  TAXON..................(RG IN 3)
        39*  SERIES NAME..........(NAME X(15) IN 38)
        40*  SIR NO...............(NAME X(6) IN 38)
        41*  PCT..................(NON-KEY INTEGER NUMBER 99 IN 38)
        42*  SURFACE TEXTURE......(NAME X(8) IN 38)
        43*  SLOPE L..............(INTEGER NUMBER 99 IN 38)
        44*  SLOPE H..............(INTEGER NUMBER 99 IN 38)
        45*  SLOPE SHAPE 1........(NON-KEY NAME XXX IN 38)
        46*  SLOPE SHAPE 2........(NON-KEY NAME XXX IN 38)
```

```
47*  SLOPE TYPE...........(NON-KEY NAME XXX IN 38)
48*  DEPTH................(NAME XX IN 38)
49*  DRAINAGE.............(NAME XX IN 38)
50*  PERM.................(NAME XX IN 38)
51*  I FACTOR.............(NON-KEY INTEGER NUMBER 999 IN 38)
52*  SOIL RS CODE.........(NAME X(5) IN 38)
53*  PROD FAV.............(NON-KEY INTEGER NUMBER 9999 IN 38)
54*  PROD NORM............(NON-KEY INTEGER NUMBER 9999 IN 38)
55*  PROD UNFAV...........(NON-KEY INTEGER NUMBER 9999 IN 38)
56*  LAND FORM 1..........(NAME XXX IN 38)
57*  LAND FORM 2..........(NAME XXX IN 38)
58*  ASPECT...............(NON-KEY NAME XX IN 38)
59*  GEOL FORM............(NON-KEY NAME X(15) IN 38)
60*  GEOL MEMB............(NON-KEY NAME X(15) IN 38)
61*  LIME DEPTH...........(INTEGER NUMBER 99 IN 38)
62*  CA DEPTH.............(INTEGER NUMBER 99 IN 38)
63*  UPDATED NAME.........(NON-KEY NAME X(15) IN 38)
64*  PARENT MATERIAL......(RG IN 38)
  65*  PM SOURCE..........(NAME XXXX IN 64)
  66*  PARENT ROCK........(NAME XXX IN 64)
```

Soil Map Unit Descriptor Dictionary

This dictionary provides a narrative explanation of the data identifiers listed in the Soil Map Unit Descriptor Directory.

ACREAGE	The total amount of the map unit occurring in the survey area, in acres.
ASPECT	The direction the slope is facing (e.g., NE - northeast)
C FACTOR	A factor used to express the influence of moisture on the surface soil particles and the average level of wind velocity on soil movement.
CA DEPTH	The depth, in inches, to a Ca horizon of the typical pedon for the taxon.
CL NIRR	Capability Class Nonirrigated - The suitability of the soil for most kinds of nonirrigated crops. The numbers indicate progressively greater limitations and narrower choices for use.
CL IRR	Capability Class Irrigated - The suitability of the soil for most kinds of field crops under irrigation. The numbers indicate progressively greater limitations and narrower choices for use.
COMMENTS	Remarks used to clarify soils data and a list of source information.
CROP NAME	The specific name of a crop grown on the associated Map Unit.
CROP UNITS	The most common means of measuring crop yield for the associated crop (e.g., BU - bushels/acre, for corn)
CROP YIELD	The name of the repeating group containing crop yield information for the respective Map Unit.
DEPTH	A code identifying soil depth (e.g., S - shallow; MD - medium depth; D - deep).
DESIGN GROUP	A grouping of soils according to cylinder infiltrometer intake families and available water holding capacities.
DRAINAGE	A code identifying soil drainage (e.g., P - poorly; W - well).
ELEV H	The highest elevation at which the map unit occurs within the survey area.
ELEV L	The lowest elevation at which the map unit occurs within

	the survey area.
GEOL MEMB	The geologic member of a geological formation associated with the soil taxon.
GEOL FORM	The geological formation which is associated with the taxon.
I FACTOR	A factor used to identify soil erodibility to wind. It is an expression of the stability of soil aggregates against breakdown by tillage and abrasion from wind erosion.
INCL SOILS	The soils which are included in the Map Units.
INCLUDED MAP UNITS	The name of the repeating group containing soil Map Unit information for the respective survey area.
IRR YIELD	The reported yield of the particular crop when irrigation is used.
LAND FORM 1	A code identifying the primary land form associated with the taxon.
LAND FORM 2	A code identifying the secondary land form associated with the taxon.
LIME DEPTH	The depth, in inches, to lime (CaCO3) of the typical pedon for the taxon.
LOCATION	The general location of the soil within the survey area (e.g., W - west).
LRA	The symbol used to identify the land resource area within which the particular Map Unit is located. (e.g., H72).
MAP UNIT INFORMATION	The name of the repeating group containing the Map Unit portion of SRIS.
MAP UNIT NAME	Correlated name of the particular Map Unit, as it appears in the Soil Survey Report.
MGT	Management alternatives for the soil for various land uses.
NIRR FARMLAND	Identifies those Map Units which have a high potential for dryland crops. This category has been identified as Important Farmlands of the state.
NIRR YIELD	The reported yield of the particular crop under nonirrigated farming.

PARENT MATERIAL	The name of the repeating group containing information concerning the developing material of the respective soil series for a Map Unit.
PARENT ROCK	A two digit code specifying the source of parent material (e.g., H2 - calcareous shale).
PCT	The percentage of the named component within a Map Unit.
PCT INCL	The percentage of the Map Unit occupied by this particular included soil (INCL SOILS).
PCT OF AREA	The percentage of the total acreage of the soil survey area that the Map Unit occupies.
PERM	A code identifying the soil permeability (e.g., S - slow; R - rapid).
PM SOURCE	A code which identifies a specific method of accumulation or deposition of the parent material (e.g., A - alluvium).
PRIME FARMLAND	Identifies those Map Units which are Prime Farmlands if they are irrigated with an adequate supply of water.
PROD FAV	The potential range production of the Map Unit, in lbs/acre of dry matter, for favorable years.
PROD NORM	The potential range production of the Map Unit, in lbs/acre of dry matter, for normal years.
PROD UNFAV	The potential range production of the Map Unit, in lbs/acre of dry matter, for unfavorable years.
R FACTOR	A factor value based on rainfall amount, time and intensity for a geographical region.
SERIES NAME	The name of the soil series or taxonomic unit used to name the Map Unit.
SIR NO	The number of the Soil Interpretation Record (Soils-5) which corresponds to the particular series.
SLOPE H	The steepest slope on which this taxon is mapped within a Map Unit.
SLOPE L	The lowest slope on which this taxon is mapped within the Map Unit.
SLOPE LENGTH	The average length of the slope within a Map Unit.
SLOPE SHAPE 1	The generalized shape of the slope on which this taxon

	is primarily mapped (e.g., CON - convex).
SLOPE SHAPE 2	The generalized shape of the slope on which this taxon is secondarily mapped.
SLOPE TYPE	A code identifying the type of slope occupied by a soil taxon (e.g., C - complex; U - undulating).
SOIL INCLUSIONS	The name of the repeating group containing information concerning any included soils that exist within a Map Unit but are of too little amount to be considered part of a soil complex.
SOIL LOCATION	The name of the repeating group containing information concerning the dominant location of the respective soil Map Unit.
SOIL MANAGEMENT	The name of the repeating group used to retain information concerning any soil management practices that are considered to be of importance to this Map Unit.
SOIL RS CODE	A code identifying the range site associated with a soil taxon.
SUBCL NIRR	Capability Subclass Nonirrigated - Soil groups within the CL NIRR indicating the main limitation of that soil for nonirrigated farming.
SUBCL IRR	Capability Subclass Irrigated - Soils groups within the CL IRR indicating the main limitation of that soil to irrigation.
SURFACE TEXTURE	The texture class for the surface horizon of the taxon (e.g., L-loam).
SURVEY AREA	A three letter abbreviation for the soil survey area.
SURVEY SYMBOL	A symbol containing a concatenation of the SURVEY AREA and SYMBOL. This element can be substituted for SURVEY AREA and SYMBOL when qualification on these two elements is desired (e.g., KI01)
SYMBOL	The symbol used to identify the soil Map Unit on the soil map.
TAXON	The name of the repeating group containing information for the soil series for the respective Map Unit.
UPDATED NAME	The updated name of the taxon used if the name has been changed due to a more recent correlation.
USE 1	A code identifying the primary use of the soil (e.g., IC

	- irrigated cropland).
USE 2	A code identifying the secondary use of the soil.
USE 3	A code identifying the tertiary use of the soil.
WEATHER STATION	Identifies the weather station, by number, which has climatological data for the area where the Map Unit is mapped. This number is used as a link to the climatology data base.

ORIGIN OF SAGORIS

Soil and Geologic Overburden Resource Information System (SAGORIS) Introduction

Basic to effective revegetation and reclamation of land disturbed by surface mining activities is knowledge of the soil and geologic overburden materials which overlie the mineral resources being extracted. Since knowledge is gained through information, many efforts are currently underway to describe the nature and properties of soils and geologic overburden in relation to reclamation potential, both for assessing revegetation potential and maintaining the integrity of the environment as a whole. Sources of the data being collected include federal and state agencies as well as mining companies.

Several problems have surfaced. These problems involve availability and access to existing data, organization and form of existing data, knowledge of where data resides, and the dispersion of data collections. Serious questions are being asked regarding the levels of use of data, e.g., whether or not these data satisfy the requirements of reclamation planners and regulatory agencies and whether or not the methodologies being used are reliable and credible.

These problems can be addressed through more effective information management. The solution to these problems depends on:

1. Better information availability or analysis capabilty to lead toward a better understanding of the inter-relationships among chemical, physical and biological interactions associated with soil and geologic overburden materials and the various environments within which they occur.

2. A data analysis capability to compare soil and geologic overburden characteristics among different study areas in order that reliable extrapolation and interpretations made.

3. Improved access to data for coordinated and systematic approaches to interdisciplinary research.

4. A data storage and analysis capability of classification properties and relating these properties to each other.

All of these requirements can be satisfied by developing a user- oriented soil and geologic overburden information system (SAGORIS). This system is expected to assist the BLM in evaluating existing data and determining additional data needs and methodologies needed, and to make the knowledge of this information readily accessible to planners, administrators, scientists and other users. To do this, the information system must serve to assemble, analyze and communicate a vast amount of data on soils and geologic overburden in an orderly and unified manner, and account for user needs from its inception.

A cooperative project has been initiated between The Bureau of Land Management and the CSU Department of Agronomy and the Laboratory for Information Science in Agriculture. The project will stress the following goals:

1. Serve to assist in developing a participatory soil and geologic overburden information system
2. Integrate and create compatibility with the various sources of the above type of data.
3. Improve the facilities of BLM and related agencies and organizations for exchanging these data.
4. Identify coordinated and systematic approaches for interdisciplinary research using these data.

Objectives and Significance of the Project

Scientific information system development is an ambitious task. Further, to satisfy the goals previously stated, the information system cannot merely be a computer program for the storage and retrieval of data. It must be a dynamic, comprehensive system consisting of data procedures and methods for handling this data, and it must account for environmental factors such as the suppliers and users of data, their training and the facilities to be employed (e.g., computers, interactive terminals, etc.). Consequently, successful development of such a system should be undertaken using a phased participatory approach.

The primary project objective will be to generate alternative strategies for implementing the information system. In order to achieve this objective a parallel effort will be undertaken involving:

1. A thorough systems analysis of the sources of soil and geologic overburden related reclamation and revegetation data and demands placed upon this data by users.
2. Development and evaluation of a pilot SAGORIS to compliment analysis activities through "hands-on" demonstrations of potential features.

The analysis will yield a description of the ongoing activities of collection, analysis and use of data, focusing on the critical aspects of policy, procedures, data and resources.

The objectives of the analysis effort are to:

1. Integrate and create compatibility with the various sources of SAGORIS data.
2. Identify and investigate assessory data including climatic vegetation, land use, and map data for possible inclusion in a comprehensive database.
3. Investigate the status of data already held and how the data collection, organization and presentation can be improved.
4. Define the current data handling procedures and determine if they satisfy the requirements of data users.

5. Identify the various users of data and how they use it.

6. Discover the levels of user expertise in methods of data management. Determine additional types of training necessary.

The pilot system will provide actual experience in addressing to a limited extent the issues associated with developing and using the eventual information system. The objectives of the pilot system are to:

1. Develop a SAGORIS pilot system using the data base management system (DBMS), System 2000, available on the CDC CYBER computers at CSU.

2. Evaluate the pilot with data consisting of soil and overburden/bedrock greenhouse and laboratory data analyzed at CSU and corresponding laboratory and core drill hole lithologic log data generated by the Water and Power Resource Service.

3. Demonstrate interactive retrieval capabilities by site, depth, bedrock, soil type, chemical component, plant tissue chemical analysis component, or by other data attributes.

4. Develop potential uses or applications of the pilot system. Possible applications might include: statistical evaluation of yield, in relation to selected chemical and physical properties, organization of yield, chemical, physical or other properties by geologic unit, subunit, etc., and correlation of plant nutrient uptake with soil and geologic overburden chemical data in relation to different chemical methods of extraction.

5. Evaluate the potentials of computer and DBMS technology to assist in the storage access, and standardization of SAGORIS data and in the timely and effective use by data users.

Soil and Geologic Overburden Descriptor Directory

The following listing illustrates the layout of data identifiers within the SAGORIS pilot and their relationships to each other.

```
10*  PROJECT.......................(NAME X(10)
15*  STUDY AREA....................(NAME X(20))
20*  COUNTY........................(NAME X(15))
25*  STATE.........................(NAME XX)
30*  WEATHER STATION...............(NAME X(5))
35*  GEOLOGIC LOG OF DRILL HOLE...(RG)
  40*  HOLE NO.....................(NAME X(6) IN 35)
  45*  HOLE TYPE...................(NAME X IN 35)
  50*  LOG LOCATION................(NAME X(35) IN 35)
  55*  GROUND ELEV.................(INTEGER NUMBER 9(5) IN 35)
  60*  DIP.........................(NAME X(20) IN 35)
  65*  DATE B......................(DATE IN 35)
  70*  DATE E......................(DATE IN 35)
  75*  DEPTH OF OVB................(DECIMAL NUMBER 99.9 IN 35)
  80*  TOTAL DEPTH.................(DECIMAL NUMBER 999.99 IN 35)
  85*  LOG PERSON..................(NAME X(25) IN 35)
  90*  LOG REVIEWED................(NAME X(25) IN 35)
  95*  GH SAMPLE...................(NAME X IN 35)
 100*  FORMATION DESCRIPTION.......(NAME X(20) IN 35)
 105*  LOG CLASSIFICATION..........(RG IN 35)
   110*  LITHOLOGY.................(NAME X(20) IN 105)
   115*  DEPTH LOW.................(DECIMAL NUMBER 999.99 IN 105)
   120*  DEPTH HIGH................(DECIMAL NUMBER 999.99 IN 105)
   121*  THICKNESS.................(DECIMAL NUMBER 999.99 IN 105)
   125*  CARBONACEOUS..............(NAME X IN 105)
   130*  STRUCTURE.................(NAME X(20) IN 105)
   135*  EFFERVESCENCE.............(INTEGER NUMBER 9 IN 105)
   140*  HARDNESS..................(NAME XX IN 105)
   145*  LOG COLOR.................(RG IN 105)
     150*  COLOR...................(NAME X(10) IN 145)
   155*  LOG GRAIN SIZE............(RG IN 105)
     160*  GRAIN SIZE..............(NAME XXX IN 155)
   165*  OTHER CHARACTERISTICS.....(RG IN 105)
     170*  CHARACTERISTIC..........(NAME X(35) IN 165)
     175*  DESCRIPTION.............(NAME X(35) IN 165)
   180*  SAMPLES...................(RG IN 105)
     185*  SAMPLE NO...............(NAME X(10) IN 180)
     189*  DEPTH MIN...............(DECIMAL NUMBER 999.9 IN 180)
     190*  DEPTH MAX...............(DECIMAL NUMBER 999.9 IN 180)
     195*  GH ANAL.................(NAME X IN 180)
     196*  GH YIELD................(DECIMAL NUMBER 99.99 IN 180)
     197*  SOIL SYMBOL.............(NAME X(5) IN 180)
     200*  PH......................(DECIMAL NUMBER 99.9 IN 180)
     205*  EC......................(DECIMAL NUMBER 99.99 IN 180)
     210*  EXT NA..................(DECIMAL NUMBER 999.99 IN 180)
     215*  EXT K...................(DECIMAL NUMBER 99.99 IN 180)
     220*  EXT CA..................(DECIMAL NUMBER 999.99 IN 180)
```

```
225*  EXT MG..................(DECIMAL NUMBER 999.99 IN 180)
230*  EXT CO3.................(DECIMAL NUMBER 99.99 IN 180)
235*  EXT HCO3................(DECIMAL NUMBER 99.99 IN 180)
240*  EXT CL..................(DECIMAL NUMBER 99.99 IN 180)
245*  EXT SO4.................(DECIMAL NUMBER 999.99 IN 180)
250*  EXT NO3.................(DECIMAL NUMBER 99.99 IN 180)
255*  SAR.....................(DECIMAL NUMBER 99.99 IN 180)
260*  EXC NA..................(DECIMAL NUMBER 99.99 IN 180)
265*  EXC CA..................(DECIMAL NUMBER 99.99 IN 180)
270*  SP......................(DECIMAL NUMBER 99.9 IN 180)
275*  CEC.....................(DECIMAL NUMBER 99.9 IN 180)
280*  ESP.....................(DECIMAL NUMBER 99.9 IN 180)
285*  PCT SAND................(DECIMAL NUMBER 99.9 IN 180)
290*  PCT SILT................(DECIMAL NUMBER 99.9 IN 180)
295*  PCT CLAY................(DECIMAL NUMBER 99.9 IN 180)
300*  TEXT CLASS..............(NAME X(5) IN 180)
305*  FE......................(DECIMAL NUMBER 999.9 IN 180)
310*  ZN......................(DICIMAL NUMBER 999.9 IN 180)
315*  MN......................(DECIMAL NUMBER 999.9 IN 180)
320*  CU......................(DECIMAL NUMBER 99.9 IN 180)
325*  PCT OM..................(DECIMAL NUMBER 99.99 IN 180)
330*  AVAIL P.................(DECIMAL NUMBER 999.9 IN 180)
335*  AVAIL K.................(DECIMAL NUMBER 999.9 IN 180)
340*  PH P....................(DECIMAL NUMBER 999.9 IN 180)
345*  PH K....................(DECIMAL NUMBER 999.9 IN 180)
350*  PH FE...................(DECIMAL NUMBER 999.9 IN 180)
355*  PH ZN...................(DECIMAL NUMBER 999.9 IN 180)
360*  PH MN...................(DECIMAL NUMBER 999.9 IN 180)
365*  PH CU...................(DECIMAL NUMBER 99.9 IN 180)
370*  PH PH...................(DECIMAL NUMBER 99.9 IN 180)
375*  PH EC...................(DECIMAL NUMBER 99.99 IN 180)
380*  PH ESP..................(DECIMAL NUMBER 99.9 IN 180)
385*  PH SAR..................(DECIMAL NUMBER 99.9 IN 180)
390*  PH ANAL.................(NAME X IN 180)
395*  PA P....................(DECIMAL NUMBER 99.99 IN 180)
400*  PA K....................(DECIMAL NUMBER 99.99 IN 180)
405*  PA CA...................(DECIMAL NUMBER 99.99 IN 180)
410*  PA MG...................(DECIMAL NUMBER 99.99 IN 180)
415*  PA NA...................(DECIMAL NUMBER 999.99 IN 180)
420*  PA FE...................(DECIMAL NUMBER 999.99 IN 180)
425*  PA ZN...................(DECIMAL NUMBER 999.99 IN 180)
430*  PA MN...................(DECIMAL NUMBER 999.99 IN 180)
435*  PA CU...................(DECIMAL NUMBER 99.99 IN 180)
440*  PA ANAL.................(NAME X IN 180)
445*  HEAVY METAL.............(RG IN 180)
  450*  ANAL CODE.............(NAME X(5) IN 445)
  455*  HM SYMBOL.............(NAME X(5) IN 445)
  460*  HM VALUE..............(DECIMAL NUMBER 999.99 IN 445)
```

Soil and Geologic Overburden Descriptor Dictionary

This dictionary provides a narrative explanation of the data identifiers listed in the Soil and Geologic Overburden Descriptor Directory.

ANAL CODE	Code that defines the analysis type for the HM SYMBOL and HM VALUE
AVAIL K	The preplant analysis of available potassium from the plant digest. Measured in ppm.
AVAIL P	The preplant analysis of available phosphorous as detemined from an ascorbic acid coloration. Measured in ppm.
CARBONACEOUS	The relative degree of carbon associated with a rock type. (N - none, S - slightly, M - moderatly, H - highly).
CEC	The preplant analysis of the cation exchange capacity as calculated from an ammonium acetate extract of exchangable sodium. Measured in meg/100g.
CHARACTERISTIC	Specific characteristic of the associated rock type, such as interbeddin, moisture, cementation, etc.
COLOR	A matrix color associated with the named rock type.
COUNTY	The county name in which the study site occurs.
CU	The preplant analysis of manganese as detemined from a DTPA extract. Measured in ppm.
DATE B	The date when drilling of the associated hole began (yy/mm/dd).
DATE F	The date when drillin of the associated hole ended (yy/mm/dd).
DEPTH HIGH	The lower depth of the associated rock type. Measured in feet.
DEPTH LOW	The upper depth of the associated rock type. Measured in feet.
DEPTH MAX	The maximum or lower most extent of the associated sample. Measured in feet.
DEPTH MIN	The minimum or highest most extent of the associated sample. Measured in feet.

DEPTH OF OVB	The thickness of soil material overlying the geologic materials.
DESCRIPTION	Description of the associated characteristic (e.g. CHARACTERISTIC - moisture, DESCRIPTION - damp)
DIP	The direction and degree that the geologic bed is inclined from the horozontal.
EC	The preplant analysis of electrical conductivity (salinity) as determined from a saturation extract. Measured in mmhos/cm.
EFFERVESENCE	The relative degree of effervescence with dilute hydrochloric acid. (0 - no reaction, 1 - slight reaction, 2 - moderate reaction, 3 - strong reaction).
ESP	The preplant analysis of exchanable sodium percent as determined from a calculation of extractable cations.
EXC CA	The preplant analysis of exchangable calcium and mangnesium as determined by a ammonium acetate extraction. Measured in me/100g.
EXC NA	The preplant analysis of exchangable sodium as determined by an ammonium acetate extraction. Measured in me/100g.
EXT CA	The preplant analysis of extractable magnesium as determined from a saturation extract. Measured in me/l.
EXT CL	The preplant analysis of extractable cloride as determined by titration from a saturation extract. Measured in me/l.
EXT CO3	The preplant analysis of extractable CO3 as determined from a saturation extract of precipitation. Measured in me/l.
EXT HCO3	The preplant analysis of extractable bicarbonate as determined from a saturation extract. Measured in me/l.
EXT K	The preplant analysis of extractable potassium as determined from a saturation extract. Measured in me/l.
EXT NA	The preplant analysis of extractable sodium as determined from a saturation extract. Measured in me/l.
EXT NO3	The preplant analysis of extractable nitrate as determined by a digestive procedure of the saturated extract. Measured in me/l.
EXT SO4	The preplant analysis of extractable sulfate as

	determined by spectrophotometer from a saturation extract. Measured in me/l.
FE	The preplant analysis of iron as determined from a DTPA extract. Measured in ppm.
FORMATION DESCRIPTION	The name of the geologic formation being sampled (e.g. Fort Union).
GEOLOGIC LOG OF DRILL HOLE	Name assigned to all of the data descriptors used to describe all the drill holes and their corresponding samples for a particular project.
GH ANAL	Determines whether a greenhouse analysis has been performed on this sample (Y - yes, fails - no analysis).
GH SAMPLE	Indicates whether this sample was sent in for greenhouse analysis (Y - yes, N - no).
GH YIELD	The yield of plant growth obtained from the greenhouse sample.
GRAIN SIZE	The grain sizes associated with the specified rock type.
GROUND ELEV	The surface, or ground, elevation at the point of the drill hole. Measured in feet.
HARDNESS	The relative degree of hardness or resistance to scratching, as determined by the log person (S - soft, MS - moderately soft, SH - slightly hard, MH - moderately hard, H - hard, EH - extremely or very hard).
HEAVY METAL	The name assigned to the group of data descriptors used to indicate the type and amount of metal found in a particular sample and analysis technique.
HM SYMBOL	The symbol associated with the HM VALUE, specifying the metal type (e.g. MO - molybdenum).
HM VALUE	The amount of metal of the associted HM SYMBOL, as determined from analysis. Measured in ppm.
HOLE NO	The number of the geologic drill hole (e.g. 79-110).
HOLE TYPE	The designation of the drill hole as to the type of core taken (O - overburden, S - soil).
LITHOLOGY	The rock types found within the drill hole (e.g. sandstone, siltstone).
LOG CLASSIFICATION	The name associated with the group of data descriptors containing information specific to the rock types within

	the drill hole.
LOG COLOR	Name of the descriptor group (COLOR) used to retain multiple colors for a particular sample.
LOG GRAIN SIZE	Name of the descriptor group (GRAIN SIZE) used to retain multiple grain sizes for a particular sample.
LOG LOCATION	The legal description of the site where the drill hole is located.
LOG PERSON	The name of the individual recording the geologic log.
LOG REVIEWED	The name of the individual reviewing the completed geologic log.
MN	The preplant analysis of manganese as determined from a DTPA extract.
OTHER CHARACTERISTICS	The name of the group of descriptors used to define characteristics specific to the associated lithologic log.
PA ANAL	Field indicating whether a plant analysis has been performed on the associated sample (Y - yes, fails - no).
PA CA	The plant analysis of calcium as determined from the plant digest. Measured as a percentage.
PA CU	The plant analysis of copper as determined from the plant digest. Measured in ppm.
PA FE	The plant analysis of iron as determined from the plant digest. Measured in ppm.
PA K	The plant analysis of potassium as determined from the plant digest. Measured as a percentage.
PA MG	The plant analysis of magnesium as determined from the plant digest. Measured as a percentage.
PA MN	The plant analysis of mananese as determined from the plant digest.
PA NA	The plant analysis of sodium as determined from the plant digest. Measured as a percentage.
PA P	The plant analysis of phosphorous as determined from the plant digest. Measured as a percentage.
PA ZN	The plant analysis of zinc as determined from the plant digest. Measured in ppm.

PCT CLAY	The preplant analysis of percentage of clay as determined by the hydrometer procedure.
PCT OM	The preplant analysis of percent organic matter as determined by spectrophotometer.
PCT SAND	The preplant analysis of percentage of sand as determined by the hydrometer procedure.
PCT SILT	The preplant analysis of percentage of silt as determined by the hydrometer procedure.
PH	The preplant analysis of sample PH as determined on a saturated paste.
PH ANAL	Field indicating whether a post harvest analysis has been performed on the associated sample (Y - yes, fails - no).
PH CU	The post harvest analysis of copper as determined from a DTPA extract. Measured in ppm.
PH EC	The post harvest analysis of electrical conductivity (salinity) as determined on a saturated extract. Measured in mmhos/cm.
PH ESP	The post harvest analysis of exchangable sodium percent as determined from a calculation of extractable cations.
PH FE	The post harvest analysis of iron as determined from a DTPA extract. Measured in ppm.
PH K	The post harvest analysis of available potassium from an ammonium acetate extract. Measured in ppm.
PH MN	The post harvest analysis of manganese as determined from a DTPA extract. Measured in ppm.
PH P	The post harvest analysis of available phosphorous as determined from an ascorbic acid coloration. Measured in ppm.
PH SAR	The sodium absorption ratio as determined by calculations from the amounts of extractable CA, MG, and NA on the associated post harvest sample.
PH ZN	The post harvest analysis of zinc as determined from a DTPA extract. Measured in ppm.
PROJECT	The official EMRIA number assigned to the project (e.g. EMRIA 21).
SAMPLE NO	The coding number used to identify a drill hole sample

RESEARCH INFORMATION
-SOURCES AND SERVICES-

By Jim Stone
Division of Resource Inventory Systems (D-460)
Denver Service Center

As BLM soil scientists, our primary role is one of support. We provide soil inventory and interpretive information to improve the management of other resources. Some aspect of the soil affects nearly every other resource activity in the Bureau. As a result, our responsibility to overall land management is enlarged rather than diminished.

We cannot, however, sit back and wait for decision-makers or other resource specialists to ask for our concerns and recommendations. We must actively promote the need for and the use of soil information. To do this effectively, we need to be informed not only about soils, but also about those other resources that can benefit from our input.

The difficulty lies in the sheer amount of information. In addition, the flow of applicable research results within the Bureau is, at best, imperfect. On the positive side, however, there are several sources available which we all, as professional soil scientists, can and should be utilizing.

1. DSC Library

Although located at the Denver Service Center, this library provides information and services to all BLM employees. The library contains approximately 15,000 volumes and subscribes to over 400 periodicals, including:

Soil Science Society of America, Journal
Journal of Soil and Water Conservation
Agronomy Journal
Journal of Environmental Quality
Journal of Range Management
Rangelands

Ecology
Ecological Monographs
Forest Science
Journal of Forestry
Remote Sensing of Environment

Field personnel are encouraged to utilize District Office and State Office resources when available, but should not hesitate to contact the DSC Library for assistance. Most materials in the library collection can be loaned for 4 weeks. Interlibrary loan services are also available as well as photocopying of short articles.

In addition, the library can access over 120 computerized data bases to provide up-to-date bibliographies on nearly any subject. This service may be requested on Form 1279-2 (April 1979) or by calling or writing the library:

Bureau of Land Management
Library D-245
Building 50, Denver Federal Center
Denver, Colorado 80225

Tele: 202/234-4578 (FTS and Commercial)

---

2. Other Government Agencies

A. Forest Service

The Forest Service Experiment Stations offer perhaps the best single source of applied research information. This is due in part to the volume of work, past and present, but is also due to the excellent system for disseminating the information.

As many of you know, each Experiment Station compiles periodic listings of recent publications. These include material actually published by the station as well as selected reprints from the open literature. Listings generally come out four times annually and provide the opportunity to order single copies.

Each District and State Office should be on the mailing list of at least that station which covers their geographical area. The list should be circulated through the resources staff so that publications of interest can be ordered for the appropriate library. This will likely require that one individual be assigned the responsibility of tracking the list so that selections are made in a timely manner.

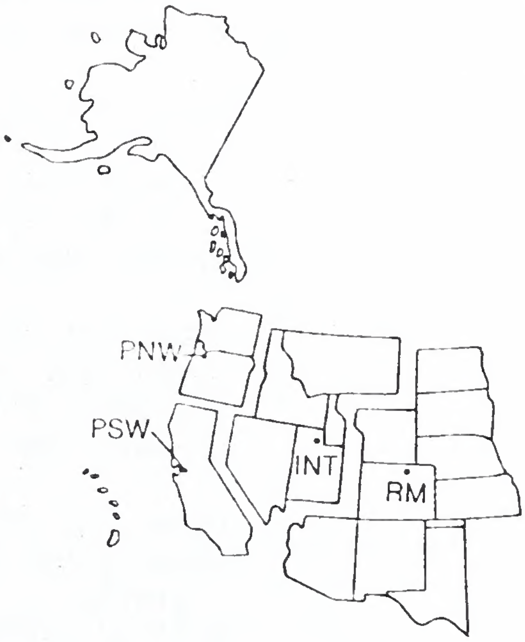
Western Forest Experiment Stations

Pacific Northwest Forest and Range
Experiment Station (PNW)
809 N.E. 6th Avenue
Portland, Oregon 97232

Pacific Southwest Forest and Range
Experiment Station (PSW)
P.O. Box 245
Berkeley, California 94701

Intermountain Forest and Range
Experiment Station (INT)
507 25th Street
Ogden, Utah 84401

Rocky Mountain Forest and Range
Experiment Station (RM)
240 West Prospect Street
Fort Collins, Colorado 80526



To get on the mailing list, write to the director at each station of interest.

B. Science and Education Administration (SEA)

SEA scientists conduct investigations on a wide range of soil-related topics. A summary of ongoing research programs is provided in:

Soil, Water, and Air Sciences Research
1980 Annual Report
USDA, SEA-AR

Range-related research by SEA staffs and cooperators is listed in "Recent Publications of Range Research". The latter publication list is currently mailed to members of the Society for Range Management. For further information on either source, write:

USDA, SEA-AR
Western Region
133 Broadway, Suite 400
Oakland, California 94612

Selected SEA research locations including a brief statement of the research emphasis are as follows:

USDA, SEA-AR Northern Plains Soil and Water Research Center P. O. Box 1109 Sidney, Montana 59270	(Management and treatment of alkaline range sites)
USDA, SEA-AR Strip Mine Reclamation Box 3354, University Station Laramie, Wyoming 82071	(Disturbed land reclamation)
USDA, SEA-AR High Plains Grassland Research Station 8408 Hildreth Road Cheyenne, Wyoming 82001	(Disturbed land reclamation)
USDA, SEA-AR Northwest Watershed Research Center 1175 S. Orchard Patti Plaza, Suite 116 Boise, Idaho 83705	(Measurement and prediction of sediment yield from rangeland watersheds)

C. Geological Survey

Through the Public Lands Hydrology Program within the Water Resources Division of USGS, considerable information has been published on soil-plant water relations, erosion and sediment yield, infiltration and soil moisture, and the effects of various land treatment practices. A list of these publications from 1950 to 1979 is available from each State Office Soil Scientist.

3. Universities

Much of the research information generated by university personnel appears in the open literature. Additional material of local interest in the form of pamphlets, circulars, bulletins, etc. is generally available through the State Extension Service. To obtain lists of available publications, write:

Director of Extension and Community Services
Colorado State University
Fort Collins, Colorado 80523

Director of Extension Service
Montana State University
Bozeman, Montana 59715

Director of Extension Service
Box 3354, University Station
Laramie, Wyoming 82071

---

4. Professional Organizations

Professional societies like the Soil Science Society of America and the Soil Conservation Society of America issue a variety of publications. Respective journals provide, in addition to professional papers, book reviews, editorials, legislative updates, and lists of upcoming meeting, symposia, and workshops. I encourage each Bureau Soil Scientist to be a member of and participate in at least one professional organization.

A new journal, entitled "Soil Survey" will begin publication in 1981. International in scope, the journal will cover soil survey methods and applications of soil survey to land use planning and land management. For additional information, contact the editors:

David Dent or Anthony Young
School of Environmental Sciences
University of East Anglia
Norwich NR 47TJ
United Kingdom

---

5. Published Bibliographies

Published bibliographies, particularly those organized according to subject matter or with a subject index, allow rapid familiarization with past research efforts. Selected bibliographies of interest are listed below.

Vallentine, John F. (ed.) 1978, U.S. - Canadian Range Management, 1935-1977: A Selected Bibliography on Ranges, Pastures, Wildlife, Livestock and Ranching. 337 p.

available from: The ORYX Press
3930 E. Camelback Road
Phoenix, Arizona 85018

price: $67.50

Gifford, Gerald F. and Everett P. Springer, 1980. A Selected Annotated Bibliography on Grazing Hydrology. Res. Rep. 50. Utah Agr. Exp. Sta., Logan, Utah. 33 p.

available from: Watershed Science Unit
College of Natural Resources
Utah State University
Logan, Utah 84322

Nickerson, Mona F., and Glen E. Brink (compilers), 1974. Publications of the Rocky Mountain Forest and Range Experiment Station. 1953 - 1973. USDA For. Serv. Gen. Tech. Rep. RM-6. 96 p.

USDA Forest Service, 1976. Rocky Mountain Forest and Range Experiment Station: A list of published research, April 1, 1972 through March 31, 1976. USDA For. Serv. Gen. Tech. Rep. RM-31. 59 p.

Colling, Gene (compiler), 1980. Bibliography of SEAM Publications. USDA For. Serv. Gen. Tech. Rep. INT-88. (Includes publications produced through Surface Environment and Mining Programs, 1974-1979)

The above publications are generally available from the indicated Forest Service Experiment Stations. Where supplies are exhausted, publications are also on file in the National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, Virginia 22161. Inquiries about the price of these publications and about catalogue numbers should be sent to NTIS at the address shown.

---

6. Newsletters

Nearly every organization imaginable issues its own brand of newsletter. A few pertinent examples are listed below.

Soil and Water Conservation News
(official publication of the Soil Conservation
Service - USDA)
12 issues/year-------Annual Subscription $10
available from: Superintendent of Documents
U.S. Government Printing Office
Washington, D. C. 20402

Public Land News
24 issues/year-------Annual Subscription $110
available from: Resources Publishing Company
1010 Vermont Ave. N.W.
Suite 708
Washington, D. C. 20005

Conservation Report
(weekly update of conservation legislation when
Congress is in session)
free to members of the National Wildlife Federation
1412 Sixteenth St. N.W.
Washington, D. C. 20036

Resources Evaluation Newsletter
(copublished by Div. Resource Inventory Systems-
BLM, and Resources Evaluation Techniques Program-
interagency group including BLM, FS, GS, FWS,
SCS)
6 issues/year-------Free of charge
available from: Bureau of Land Management
RIS, D-460
Building 50, Denver Federal Center
Denver, Colorado 80225

Landsat Data Users Notes
Published bimonthly-------Free of charge
available from: User Services Section
U.S. Geological Survey
EROS Data Center
Sioux Falls, South Dakota 57198

Many of these kinds of publications already come into BLM offices and are made available in the daily mail packets. New subscriptions can be made as deemed necessary. A few minutes each week to merely scan this information for items of interest provides an easy means for keeping current in a wide variety of subjects.

To many of you, the use of these sources of information may already be commonplace. If so, congratulations and keep up the good work. If not, there is no time like the present!

ROCKY MOUNTAIN REGIONAL MEETING
SOIL, WATER AND AIR RESOURCE WORKSHOP
JACKSON HOLE, WYOMING
FEBRUARY, 2, 1981

Jack C. Chugg, Soil Scientist
Division of Rangeland Management
Washington, D.C.

INTERAGENCY SOIL TOPICS OF INTEREST

- Soil - Vegetation - Climate Study Team (SCS, BLM, FS, SEA)

  Results of November meeting were favorable

  Study plan will be developed by BLM for consideration by other agencies

- Western Regional Meeting of the National Cooperative Soil Survey - San Diego, California - February 1-5, 1982

  "The role of Soil Surveys in Land-Use Planning" (BLM, SCS, National Aspects)

  Steering Committee

  Chairman, Chuck Goudy
  Co-Chairman, Jim Stone
  Members:
  Jack Chugg, BLM
  Dick Kover, SCS
  Fred Peterson, Univ. of NV, Reno, NV.

-- Soils Manual 7100 - Eventual Incorporation into the National Soil Handbook, starting with policy statements. This will take about one year.

- National Assessment (BLM, SCS, FS, SEA)

  3/81 4-agency statement on coordination of policy, management planning, and program development actions at the National, Regional, State and local levels

- Soil Survey Manual

  Chapters are coming as notices in the NSH, the BLM will have input into the range and Forest sections.

March 3, 1849

IN REPLY REFER TO

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
District Office
P.O. Box 1869
Rock Springs, Wyoming 82901

THE ECOSYSTEM APPROACH TO STREAM HABITAT MANAGEMENT

Bruce H. Smith, District Fisheries Biologist,
U.S.D.I., Bureau of Land Management
P.O. Box 1869, Rock Springs, Wyoming 82901

Abstract

With our increasing awareness of the value and importance of stream and riparian ecosystems, it will be necessary to achieve a more effective interdisciplinary approach towards total watershed management. The numerous impacts and problems presently experienced by stream ecosystems are indicators of greater soil or water resource problems associated with the management of public lands. As habitat values are reduced for the aquatic ecosystem, resource productivity is also reduced for all programs. Through effective application of "ecosystem engineering" principles, subsequent improvements in aquatic habitat can reflect the results of improved watershed management for all resources.

DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
1981 FEB 12 AM 10:00
RECEIVED
CHEYENNE, WYOMING

(P1) In the course of my employment with the Bureau, I have often noted an ongoing debate, over which resource program is most basic in the management of public lands. It has been stated on several occasions that good range management is good soil and watershed management. On the other hand, it has also been stated that you can't begin to have good range management, without first having soil and water resources in a stable and productive condition. In order to lay this controversy to rest, I feel that if we all take an objective look at the big picture from an ecosystem viewpoint, it will be quite evident to all parties concerned that, the "quality of fishing, reflects the quality of living!" (P2) For it is the aquatic biologist who, in monitoring and managing aquatic communities and their habitats, is in fact working with a plethora of indicator organisms and habitat conditions. His entire resource is determined by the condition of existant soil, water, vegetation and land use management practices. (P3) In the western United States, the stream ecosystem is confined to a mere fraction (usually less than 1% and often less than 0.1%) of our total land base. (P4) This stream ecosystem is most immediately defined and easily recognized by its associated riparian zone community. (P5) While it is possible to simply have water flowing down a channel, defined by soil type, these basic physical elements provide utility and benefit to the resource base only if a viable and productive stream ecosystem exists in form, structure, and function.

(P6) In an ecological sense, succession is an ongoing function of all aspects of the landscape, both physical and biological. However, while geologic or morphologic succession is evident to physical scientists dealing with soil and water resources, the rate and type of succession which occurs is largely influenced by the interactions of all biological organisms, man included. In the case of stream ecosystems, we have found that two important elements in this succession are changes in the riparian plant community and the associated effects of beaver activity. In geologically young reaches of a drainage, we typically find narrow, deep channels, with early stages of riparian plant communities (such as aspen) and recent beaver activity. In intermediate reaches of the drainage, past beaver activity has resulted in the accumulation of sediment, an alteration in soil type and moisture availability, and development of a willow dominated community, as the original riparian aspen community begins to be invaded by spruce or fir. At the most advanced stages of succession, the riparian aspen community may be entirely overtaken by a climax spurce/fir forest and the immediate riparian stream community has developed a highly productive willow/grass association. (P7) This succession may occur within different reaches of the same drainage, or it may exist between drainages, where the entire stream is in one stage or another. (P8) The role of beaver activity in this process cannot be overstated. As a major stabilizing agent within a watershed, the influence of balanced beaver activity, (within carrying capacity) can mean the difference between a typical cold desert stream such a Currant Creek, with less than one acre of riparian meadow per mile, or a stream with five acres of riparian meadows per mile. (P9) This is the same stream as the former picture, the only difference being in location and the type of land use which is occurring. (P10) As an example of the benefits received from beaver activity, consider the fact that coming off of public lands, this stream was found to be carrying a suspended solids load of 1,400 mg/l in the spring of 1980. (P11) After flowing through five miles of private land, with well developed riparian habitat and a good frequency of beaver dams, this solids load was reduced 90%, to a mere 168 mg/l. (P12) After flowing through only 1 1/2 miles of pasture, in a declining riparian condition with little or no beaver activity, this sediment load increased to 1,150 mg/l! (P13) However, after leaving the ranch and once again flowing through public lands, the stream's sediment load was up to 4,590 mg/l within the next two miles!

(P14) One of the main problems affecting the condition of stream ecosystems on public lands is the intensive use this limited area receives. Riparian zones in the Rock Springs District have been found to be a critical habitat element for 75% of all wildlife species occurring in the sagebrush steppe, or cold desert environment. (P15) In the forested montane region, this figure approximates 60% of all wildlife species. In addition, intensive livestock grazing of riparian zones has been found to exceed 75%, and often approaches 100%, utilization of available forage annually. (P16) While salt may be the spice of life, the cumulative effects of intensive livestock grazing pressure may result in something more (or less) than is desired for the productive management of public riparian zones. (P17) Reviewing the present condition of many stream ecosystems on public lands, it is difficult to make a strong case for continued multiple use management. (P18) With a decline in basic productivity of riparian zones, our present management in many areas is reverting the landscape to earlier stages of geologic succession. (P19) Once again we have a high degree of soil surface exposure, a compacted and erosive condition, accelerated runoff leading to gully erosion, with increased soil movement and decreased stability of the hydrologic functions and processes within the entire watershed. As this sequence of events continues (P20, 21, 22) the productive capacity of the stream ecosystem declines for all uses. Where were once had forage production measured in thousands of pounds per acre, we now have hundreds of pounds per acre. Water tables and bank storage decline as the channel headcuts, accelerating erosion. At this point the aquatic biologist and his resource become an endangered species. (P23) With time and the reestablishment of hydrologic equilibrium, the opportunity once again exists for establishing initial seral plant communities and putting stability back into the system, with assistance from beaver.

(P24) This discussion is not meant to focus solely on the effects of livestock grazing programs, because other uses are also affecting our stream ecosystems as well. (P25) Oil and gas exploration and development is also having an increasingly significant impact. Direct physical alteration of riparian community structure has been found to alter the hydrology of some streams to a degree that far exceeds the impacts incurred from grazing. In this instance, (P26) seismic exploration on Raymond Creek, combined with beaver activity, altered the flow characteristics of a formerly stable ecosystem, (P27) resulting in severe gully cutting within only a four year time span. (P28) Energy related road developments also continue to impact stream habitat through alteration of stream flows. (P29) Despite numerous management workshops and publications pertaining to proper culvert placements, we continue to experience impacts to stream habitat through accelerated flows and bank erosion. (P30) To a large degree, many of the "habitat improvement" actions of the aquatic program amount to merely trying to reduce impacts from other, development oriented, programs. (P31) Even activities as inoccuous as weed control, through spraying of broad spectrum herbicides along riparian zones, (P32) can lead to the reduction or loss of stabilizing riparian plant communities and the initiation of long term, large scale impacts due to erosion.

We can continue to conduct programs of impact mitigation (P33) through instream habitat improvement at costs of $25,000 or more per mile. Or, we can attempt total physical stabilization of watersheds at costs exceeding $100,000 per mile. (P34) But realistically, can we afford this type of a "management" program? Or, better yet, can we afford the consequences associated with these impacts? (Increased salinity, soil erosion, lost productivity, water storage, carrying capacity, etc.)

In the Rock Springs District, we are attempting (P35) to illustrate to the public that there are alternatives for better riparian management, in order to avoid impacts. On just about every type of riparian ecosystem in our district, we have initiated special management, study or rehabilitation programs within a series of riparian exclosures on streams, wet meadows, aspen or willow stands and gullies. Hopefully, these areas will help us illustrate what can be done to improve and restore the productivity and function of riparian stream ecosystems. (P36) Consider, for example, the changes noted over four years of study in our Huff Creek study exclosure. As a pilot study conducted prior to the implementation of our Thomas Fork Habitat Management Plan, we were interested in determining the time frames associated with returning a degraded stream habitat (P37) (noted in the first illustration, with a wide shallow channel, extensive deposition, etc.) to a productive stream habitat (noted in the last illustration, with a narrow, deep channel with stable undercut banks) for the sensitive, and proposed as threatened, Bear River cutthroat trout. (P38, 39, 40, 41) Over the four years of study and rest from livestock grazing, we have observed an initial stabilization of the channel (over the first two years), followed by improvement of instream habitat elements (pool/riffle ratio, bottom composition, width/depth ratios, etc.). While improvements are still continuing to occur, to date we have noted an almost 100% increase in average depth (0.32 ft. to 0.58 ft.); a shift in pool/riffle ratios (from 80-20 to 65-35); an improved bottom composition and production of aquatic insects; a 52% increase in total fisheries standing crop; a 70% increase in trout standing crop and an 83% increase in numbers of trout per mile.

(P42) In a drainage where extensive acreage of riparian meadows has been lost and range productivity reduced (due to the factors noted earlier) (P43) we have compared range conditions outside of our study, (P44) to those conditions inside of our study and found an increase in forage production of 1,800 lbs./acre! You can call this an increase, or restoration, but the point to be made is that, with better management (P45, 46, 47, 48, 49) riparian soils will recover from compaction; infiltration will increase; soil structure and bank water storage will improve, leading to the reestablishment of wet meadow sites where dry meadows have been the rule, rather than the exception. The present procedure of reducing livestock numbers will alone, provide only a short term respite at best, under conditions of declining productivity. (P50) Better and more effective range management will provide the only permanent solution to soil, water, vegetation, and aquatic resource problems associated with stream ecosystems. (P51) For it is these areas which have the potential for the most immediate response and the greatest improvement. Unfortunately, it is these same areas which, to date, have received very little specific management considerations within our applied land use programs.

To this end, our districts' aquatic resource programs have been working towards a concept I refer to as "ecosystem engineering." It is similar in nature to what we talk about in the field of ecosystem management; it is very similar to what we continuously read and write about in the field of multiple use management; however, ecosystem engineering is slightly different in that its emphasis lies in the actual application of these principles, rather than in their repeated recitation.

(P52, 53, 54, 55) For example, we have found that it is possible to accelerate the restoration of riparian dry meadow sites with treatment by fire and rest from livestock grazing for one or two years. This reduces the time requirement for meadow restoration, (through vegetative succession, with rest, as noted earlier) from five to only two years. For instream improvement and water table elevation (P56) we have also found that it is also possible to identify limiting environmental factors, (in this case, large building materials for beaver) and by providing the limiting factor, (P57) to enable us to work *with* natural systems (P58) in order to acheive the desired results (P59) in not only a natural manner, but at ten to twenty five percent of the alternative cost. In the interim, short term site specific protection utilizing for example, electric fences, (P60) can provide the needed treatment for (P61) eliciting a regeneration of critical system elements (such as willows), for long term system maintenance and function. These are only a few examples of what can be done, but they serve to illustrate the potentials which exist for real, honest to goodness, on the ground, applied soils, water and resource management.

On a system wide basis the results which can be achieved are considerable, as we have found in our Bone Draw special management unit. (P62) Few people would/could recognize the potential of this stream five or six years ago. And practically no one believed it could be a highly productive riparian system, with management potential for trout. Yet today, (P63, 64) after being placed under a special management program, the drainage *is* stabilizing and stream habitat *is* improving. Applying the principles of ecosystem engineering, we attempted to "put together" an anadromous fisheries ecosystem. (P65) With the aid of fish egg incubation boxes, assistance (P66) from members of the Izaak Walton League of America and (P67) instream artificial gravel baskets in lieu of natural spawning redds, we have been (P68) able to successfully hatch and rear rainbow trout in this stream for the last four years. (P69) After displacing downstream to the Big Sandy River, from there to the Green River and possibly all the way down into the Flaming Gorge, (P70) these fish are now returning to Bone Draw and a yearly run of rainbow trout (P71, 72) is developing in 40 miles of the Big Sandy River. Forty miles of river which, through ecosystem engineering, will provide a new recreational resource base for southwestern Wyoming.

(P73) So the next time you meet an aquatic biologist, keep in mind that contrary to alot of people's opinions (P74) he is not just playing in the water. He is in fact, (P75) working with an extensive and complex array of biological organisms and physical habitat conditions. The biological structure and function of all elements within the stream ecosystem provide him, and the land manager, with an almost unlimited source of indicators, by which to assess the effectiveness or impacts of our land management programs. (P76) And when you meet an aquatic biologist who seems to be fighting for his resource, bear in mind that he ismost probably, struggling for survival under conditions over which he has little control. He is in fact, fighting for *your* resource and its proper management. (P77) For, by the time our fish start going "belly up," the show will be over for all of us.

PRESENTATIONS MADE ON
FRIDAY, FEBRUARY 6, 1981

BRIEFING ON THE DENVER SERVICE CENTER'S DIVISION OF SPECIAL STUDIES

by Eric B. Janes
Project Studies Chief, D-450

The Division of Special Studies, under the Division Chief, and through several Project Studies Chiefs, organizes facilities, equipment, and computer support to complete special studies assigned by the Headquarters Office. These studies include both nonrecurring short-term and long-term projects. Work addresses basic resource management problems and solutions which demand highly technical skills, close collaboration with the field clientele and outside groups, and a mixture of discipline viewpoints.

Technical Development and Services. The staff does the following:

1. As assigned and approved by the Headquarters Office, develops procedures and implements special projects primarily related to natural resource management at the Bureau, State, or local level.

2. Provides technical expertise, assistance, and an organizational framework to organize facilities, equipment, and personnel efficiently and effectively to carry out special project assignments.

3. Participates in training, documentation, and instruction, and assists in the study, research, or development of assigned special projects.

4. Analyzes existing policies and procedures related to special projects as assigned.

Goals and Objectives

D-450 is a multidisciplinary team that houses expertise in several natural resource programs. We are best characterized by our multiple-use objectives. For example, we are engaged in studies that include:

1. Development and rehabilitation of coal lands.

2. Reduction of salinity impacts to the Colorado River.

3. Development and protection of groundwater resources.

Presented February 6, 1981 at Jackson, Wyoming at the BLM Northern Rocky Mountain Regional Soil, Water, and Air Workshop.

4. Forest allowable cut studies, analysis, and recommendations.
5. Interaction of surface and groundwater supplies and the impact of coal mining on these resources.
6. Impacts of various grazing systems on the public rangeland, i.e., runoff, erosion, and sediment discharge.

Policy Assumptions

1. BLM is committed to improving public rangelands through legislation such as the Public Rangelands Improvement Act (PRIA). The PRIA will provide funding to accomplish these objectives.
2. BLM is committed to protection and proper management of both surface and groundwater resources. This includes management of impacts resulting from coal mining and grazing on the Public Land. This commitment has legislative foundation in several water-related Public Laws and Executive Orders.
3. The Bureau is committed to full evaluation of the environmental effects of changes in Livestock Management Systems. DSC will continue to be responsible for the watershed condition and water resource components of the Saval Ranch Research effort that focuses on livestock management systems.
4. The Bureau will quantify the runoff, infiltration, soil loss, and water quality changes brought about from implementation of RMPs and activity plans.
5. DSC will continue to manage the Technical Support Program to coal development, through advice and goals promulgated by the Office of Coal Management.
6. The Division of Special Studies, D-450, (DSC) will support the entire Public Domain timber management function including ES and EAR commitments, forest inventory, timber production, potential harvest yield computations and intensive forest management practices for timber production and related forest products.

Overview

D-450 contains the following programs:

1. Coal Program (Technical Support) (4112)
2. Groundwater Development/Management (4340)
3. Colorado River Salinity Study (4340)

4. Saval Ranch Research Project (4340)
5. Upland Hydrology Effects Study (4340)
6. Resource Hydrology Assessment Group (4340)
7. Instream Flow (4340)
8. Forest Allocation and Production (4310)

D-450 also provides support/funding for several projects in other divisions:

D-414 - Photogrammetry

D-415 - Mapping

D-420 - Engineering

D-440 - Scientific Systems Development

D-460 - Resource Inventory Systems

Jim Peterson
MSO 930

Rocky Mountain Regional Meeting

[illegible] spoke on [illegible]

Objectives and BLM participation in the NADP.

BLM's role in the identification of air quality related values.

A. The Objectives of NADP

This program, known as the National Atmospheric Deposition Program (NADP), consists of an interdisciplinary team of about 100 research scientists and initial planned network of 75-100 collection sites throughout the U.S. There are some 80 operating sites with more sites being planned in 1981. The participating institution and agencies include 21 State Agricultural Experiment Stations, 4 U.S. Forest Service Experiment Stations, the Illinois State Water Survey and 7 other state or private research organization and universities in the United States and Canada. Numerous other agencies are contributing to the support of this project.

B. Monitoring Network

This slide shows the states and regions in which collection sites were established as of 1980. All collection sites have been selected to give accurate and representative information concerning spatial and temporal variations in the chemistry of precipitation and dry particulate matter within the major physiographic regions of each participating state and region.

Each site is equipped with an identical collector of wet/dry deposition (Aerochem Metrics Model 301), a recording rain gauge and Ph and conductivity meters. Samples of precipitation and dry particulate matter are collected at each site on a regular weekly basis and shipped to the central analytical laboratory for analysis.

C. Analysis and Analytical Services

To insure that the network data are of such high quality that they provide maximum credibility for a wide variety of fundamental research and mission oriented purposes, a Quality Assurance Committee of impartial experts is critically overseeing the selection and operation of each collection site, as well as the operation of the Central Analytical Laboratory. The U.S. Geological Survey, with the cooperation of the Environmental Protection Agency and Department of Energy laboratories, has agreed to conduct an extensive quality assurance program to meet criteria established by the Quality Assurance Committee.

D. Availability of Data

Data obtained by the network is provided to all participating agencies. Any portion or all of the data will be provided upon request for any purpose of analysis and interpretation by personnel of any agency, public or private, which may wish to use the data. A highly flexible, computerized printout system will provide the data. This is achieved by providing various types of sums, averages, correlations, time-course plots and spatial variations plots. A proposal has been received from EPA to develop and support a data system to serve NADP and other atmospheric monitoring programs.

E. Financial Support

Funds for the coordination of the project, as a whole, have been provided by the North Central Regional Association of Directors, the Cooperative State Research Service, the U.S. Geological Survey, the U.S. Forest Service and the Agricultural Research. The costs of establishment and operation of each collection site and analysis of precipitation and dry particulate matter are borne by each institution participating in the project.

F. Organization

The Regional Project is governed by a Technical Committee including representatives from each participating institution or agency. The project is operated by an Executive Committee under the authority of the Technical Committee. Five subcommittees have been organized to provide technical direction for each of the program's major phases.

Any person or agency wishing to participate in this Regional Project should contact the Project Development Coordinator (J. H. Gibson), Natural Resource Ecology Laboratory, Colorado State University, Fort Collins, Colorado 80523.

North Dakota is presently operating a site in the Dunn Center area, without belonging to the NADP network. This program is just getting started, as they feel they can do the analytical aspect for less money.

Air Quality Related Values
(only Class I areas)

The only "air quality related value" specifically cited in the 1977 Amendments is visibility, other values may include fish and wildlife, soil, vegetation, and water resources and archeological sites. The EPA has yet to provide general guidelines regarding the evaluation of impacts of proposed emitting sources on air quality related values and, until such guidance is available, determinations are to be made on a case-by-case basis. The FLM reviewing the permit can ensure protection of air quality related values. For example, the FLM can require a facility to monitor the impacts of the emision and reduce their level if adverse effects begin to occur.

BUDGET FOR ESTABLISHING AND OPERATING MONITORING SITE

A frequently asked question is the cost for establishing and operating a monitoring site. Exact figures for a given site depend on location, available personnel and available equipment. The following figures are presented to help in estimating the initial and recurring expenses that may be incurred. It is assumed that the available site has 110 volt power, personnel to collect samples weekly and no unusual problems in locating the sampler. The cost of certain items may vary, depending on the manufacture selected.

Initial Costs	
*Aerochem Metrics Model 301 Collector (including estimated postage)	$1,500
Belfort recording rain gauge	$ 500
pH meter	$300-400
Conductivity meter	$300-400
Recurring Costs	
Chemical analysis (58 samples x $58.50)**	$3,400
Postage (estimate)	$ 240

*Required manufacture and model.

Costs are subject to change, as quoted figures are early 1980 prices.

42
copy

NOT ALL BEAVER ARE BAD; OR, AN ECOSYSTEM APPROACH TO STREAM HABITAT MANAGEMENT, WITH POSSIBLE SOFTWARE APPLICATIONS

Bruce H. Smith, U.S.D.I., Bureau of Land Management, P.O. Box 1869,
Rock Springs, Wyoming 82901.

Abstract: Pilot studies in the Rock Springs District have indicated the establishment of stream habitat improvements can be achieved through a "software" approach of providing environmental limiting factors for beaver, i.e., necessary material and food supplies. When applied within a multiple-use management framework, this approach could prove to be highly compatible with other programs (e.g., aspen thinning to stimulate big game browse regeneration).

In addition, when compared to physical instream improvements, the approach could be quite cost effective in light of present material, installation, and maintenance costs.

Introduction

The Rock Springs District stream inventory of 1975-1977 evaluated 1,143 miles of stream habitat on public lands, in order to develop baseline information for the Bureau's multiple use programs. One of the major findings of this inventory was the reduced habitat quality and carrying capacity of many mid-sized streams with flows of 1-10 cfs. Insofar that these reductions are due in large degree to excessive bank erosion, stream bottom sedimentation and reduced quality of resident pool habitat, independent recommendations have been proposed (Behnke, 1976) to mitigate losses in game fish carrying capacity through the construction of reservoirs. While this is a potentially viable mitigating measure, there are limitations for implementation within existing program funding levels, state's water rights conflicts, etc. By taking a "software" approach to the problem, however, natural systems are often found to exhibit extensive on stream water storage sites in the form of beaver ponds, which can significantly increase the productivity and carrying capacity of a free flowing stream (P-1). During the stream survey, on stream beaver ponds were evaluated in relation to their fisheries habitat significance. A Districtwide set of average conditions was subsequently developed (Table 1), from which individual streams or drainages could be compared.

Table 1

On Stream Beaver Pond Habitat-District Stream Survey 1975-1977

No. Ponds Sampled	Average No./Mi.	Average Size		Av. Max. Depth	Fish Blocks
		Ft^2	Acres		
1,509	1.3	1,408	0.03	2.0 ft.	48%

Active	Inactive	Silted	Not Silted	Fresh Water	Stagnant
50%	50%	89%	11%	91%	9%

Through analysis of the entire stream survey, it became apparent that stream habitat quality was often directly related to the condition of associated beaver complexes and their riparian zones.

Methods

Recognizing relationships between the total stream community and particularly, requirements for improved management of beaver related habitat, cooperative interagency (BLM and Wyoming Game and Fish) habitat management plans (for the Thomas Fork drainage and the East Front of the Wyoming Range) have identified objectives for the improvement of beaver habitat areas to enhance the survival of both the Utah cutthroat (*S.c. Utah*) and the Colorado River cutthroat trout (*S.c. pleuriticus*).

Call (1966) found that aspen supported beaver habitat in southwestern Wyoming approximated a thirty year boom and bust cycle (P-2). Typically, beaver move into a drainage and utilize aspen 200 to 300 feet from the stream (depending on slope). With the ultimate elimination of their food and material supply, subsequent sedimentation of the ponds and a transition into a marsh meadow habitat, beaver moved out of the area (P-3). During their absence, the aspen regenerate themselves and eventually, beaver move back into the drainage and once again begin developing on stream pond habitat. Rutherford (1964) identified numerous variables or environmental factors between different types of beaver populations and the niches which they occupy. These include the differentiation between river bottom, plains, or mountain beaver populations which are supported by cottonwood, willow, or aspen/willow plant communities, respectively. In addition, physical factors such as soil type, stream gradient, geological land-forms and location within the drainage significantly influenced the success or failure of beaver establishment within a given reach of stream.

In the analysis of our stream inventory however, we found that it was difficult to apply any given cycle or standard set of conditions to define stream habitat related beaver ecology and riparian succession. Each stream was unique and existent habitat conditions were part of an ongoing dynamic interplay of all affecting forces, both physical and biological. As an example, it appears that many streams with aspen supported beaver complexes are not cycling at all; or may possibly be cycling in the neighborhood of 75 to 150 years (P-4). The gradual invasion of spruce/fir communities into former (or present) aspen occupied riparian zones leads to a climax situation, typical of a montane meadow type stream

(P-5). As another example, where beaver habitat is primarily supported by willows, the dams constructed are typically small, short lived, have trout habitat value for only two or three years, and may be cycling as rapidly as every five years (P-6, 7, 8 shows the same willow supported beaver pond series in 1974, 1977, and 1979, respectively). It appears that in areas with well established willow riparian zones (P-9), beaver activity may actually stimulate willow growth and can occur on a long term basis. While individual dams or groups of willows may phase in and out of the system, the influence of beaver activity on the overall stream can probably continue indefinitely.

In those riparian areas with both active beaver populations and intensive livestock grazing (P-10), it has been found that continued use of riparian vegetation without rest treatments (P-11) leads to a downward trend in not only stream habitat, but most resource values as well, livestock grazing included (Smith 1978). The loss of food and material supplies required to support the stabilizing influence of beaver activity, leads to progressive channel downcutting (P-12, 13, 14, 15), a lowered riparian water table, reduced bank storage and meadow carrying capacity, accelerated erosion, decreased watershed stability, plus a host of lost opportunities tied to ramifications of these basic impacts. In reaches of streams flowing through the cold desert biome, the loss of this stabilizing influence is even more dramatic (P-16, 17, 18). The quality of stream habitat for game fisheries in these situations is not merely reduced, but is often completely lost altogether. This degradation process continues until the channel approaches some level of hydrologic equilibrium and willows begin to re-establish (P-19), providing the basis for a regeneration of beaver influence on stream habitat (P-20).

Numerous differences between the conditions of beaver habitat (P-21) have been found to vary not only between drainages or individual streams, but also within separate reaches of the same stream. On a given stream, originating in a montane area and flowing out onto the cold desert, it is often possible to observe at least four distinct types of stream habitat associated with beaver activity. Typically, the stream starts out in a coniferous forest flowing through a meadow where signs of old beaver activity (dams, terraces, etc.) are still evident. The next reach exhibits remnant aspen stands, cut back from the stream and presently being invaded by conifers. On south facing slopes, less favorable for coniferous invasion, remnant aspen stands appear to be determinate (Gullion 1979) in nature and in a decadent or declining condition: Stream bottom habitat in this zone is primarily influenced by the existence of large, old, aspen based dams. Dams which are presently silting in, forming a wet meadow riparian zone and are providing the basis for extensive willow growth which provides materials for the maintenance of the old dams and construction of newer, smaller dams. The next zone is characterized by aspen stands cut back from the stream during recent dam building activity. The beaver dams are typically large, due to the utilization of aspen for materials; the ponds are generally young with good size and depth for trout habitat. The riparian zone is small or indistinct and willows are in the process of becoming established as the ponds begin to silt in (P-22). Having made the transition out onto the cold desert plains, many streams then become gully cut resulting in marginal game fish habitat. Only edifices of former riparian plant communities and the beaver complexes which they supported remain to illustrate the type of habitat which once existed.

Results

Historically, most discussions dealing with beaver habitat management have focused on negative aspects of the observed "boom and bust" cyclic nature of beaver activity. As an example, a typical reach of stream in which beaver activity had been developing since the early 1970's (P-23) showed signs of gradual habitat improvement and riparian utilization until 1978. By 1979, however (P-24), beaver populations increased to the point of almost complete utilization of riparian food and material supplies and a "bust" was imminent (P-25). At this point, the usual management requirement calls for an immediate reduction in population numbers. One of the most difficult ways to try and manage these natural cycles for extended productivity and maximum resource benefits, however, is through the utilization of equally volatile fur market demand and harvest activities (Hodgdon 1978). Both cycles seldom coincide and often, during periods of beaver abundance, we have found (P-26) instances where beaver attempt to establish themselves in sites which appear to be entirely unsuitable, to say the least. Out of necessity, they must often resort to utilization of greasewood, sagebrush, rabbit brush, or any available materials in an attempt to create (P-27) the habitat necessary for their survival. Quite often, under these same conditions (P-28) resource management agencies are faced with the problems of trying to improve degraded stream habitat for fisheries survival, watershed stabilization, riparian restoration, etc. In many instances, the applied method of improvement involves the installation of instream "hardware," such as gabion structures (P-29) or log drops (P-30). In addition to the initial capital investment required to install these types of structures, an ongoing and ever-increasing committment of funds is necessary for site maintenance, in order to keep the structures functional (P-31, 32).

Discussion

Every once in a while, during a lapse in the usual deadlines, brush fires, and crises which seem to characterize the general trend of business today, one has a few brief moments in which to sit back and think. It was during one of these rare moments that the thought occurred to me (P-33); "Here we are, with decadent or overmature aspen stands on slopes and ridge tops. Management programs are being developed to stimulate suckering and browse production in these stands through the use of controlled burns or cutting programs. On the other hand, adjacent drainage bottoms are in a declining trend and beaver are down to utilizing any material available in order to try and maintain their habitat and associated benefits to the watershed. Why not try to adopt a 'software' approach to solving some of our stream habitat problems and at the same time, obtain additional benefits from the aspen management programs?" Enter Operation SANTA CLAUS! (P-34).

Why wouldn't it be possible to reduce or eliminate capital investment costs and simply operate a program based on our usual time requirements for maintenance? Possibly, we could supply the limiting factor, a material and food supply, to these beaver and maybe, just maybe, they would perform the installation and maintenance activities for us. (!) (?)

Initial inquiries made to friends within the region about the rationality and feasibility of this idea most often resulted in a dubious or skeptical response, to put it mildly. However, after two years of trial and testing, the idea appears to be not only feasible, but may have valid applications in areas where other methods of stream improvement may be too costly or technically unfeasible (P-35).

It is possible to provide food and material supplies to beaver and have them improve stream habitat (P-36). These structures can, in fact, survive spring runoff, during which they provide for sediment storage, an elevated water table and bank recharge through over bank flows (P-37). With additional supplies of materials after spring runoff (P-38), beaver will not only maintain their present structures (P-39), but may even build new dams in the immediate area of supply (P-40, 41).

Summary

In order to work within an ecosystem framework towards solving resource management problems, it is desireable to look at the "big picture" and identify all affecting elements and limiting factors for the entire habitat site. This includes both physical and biological factors. In order to apply a "software" approach and work with beaver for stream habitat improvement (P-42), it is necessary to try and think like a beaver (P-43, 44). In light of all the limiting factors affecting beaver habitat establishment (P-45), (soils, stream flows, gradient, landform, food and material supplies, behavior, biology, etc.) I personally feel that beaver are basically opportunists (P-46). Opportunists with a large capacity for adaptation (P-47). The benefits which can be attained for fisheries habitat may be quite significant, especially when compared to the instream habitat conditions which would normally exist (P-48). In addition, secondary benefits may be realized through the establishment of an elevated water table, subsequent creation of new spring sources further downstream and the enhancement of the entire riparian zone (P-49). This method is by no means a solution to all of our problems. It is merely a method which has been shown to work. But in those areas where it will work (P-50), it once again restates the fact that, "It's pretty hard to beat a beaver!". For instream habitat improvement with multiple use benefits, there is a large degree of personal satisfaction in being able to work with a natural system, instead of against it or in spite of it.

References

Behnke, R. J. 1976. An Analysis and Determination of Salmo clarki utah Purity and Significance in National Resource Land Streams of the Thomas Fork Drainage: With Observations of Aquatic Habitat Problems. Prepared for BLM, Rock Springs District, Kemmerer Resource Area, Wyoming.

Call, M. W. 1966. Beaver Pond Ecology and Beaver Trout Relationships in Southeastern Wyoming. University of Wyoming - Wyoming Game and Fish Commission, June 1966.

Gullion, G. W. 1979. Aspen Management Activity Report, made to the Division of Range and Wildlife, Region 2, U.S.D.A. Forest Service, Denver, Colorado.

Hodgdon, H. E. 1978. Social Dynamics and Behavior Within an Unexploited Beaver (Castor canadensis) Population. PhD. dissertation, University of Massachusetts Dept. of Wildlife and Fisheries Biology.

Rutherford, W. H. 1964. The Beaver in Colorado: Its Biology, Ecology, Management and Economics. Colorado Game, Fish and Parks Department, Game Research Division, Technical Publication Number 17.

Smith, B. H. 1978. Completion Report, Rock Springs District Stream Survey, 1975-1977. Bureau of Land Management, Rock Springs District, Wyoming.

Snow Management on Rangelands*

Wind-transported snow can be managed to increase water supplies for livestock, wildlife, and irrigation. Successful snow management to increase water yields is based on estimating the total quantity of wind-borne snow (less evaporation losses during transport) arriving at a specific location. This quantity is estimated by:

$$Q_T = \frac{R_r R_m}{2} \left[1 - (0\ 14)^{R_c/R_m} \right] \qquad \text{where}$$

Q_T = Water-equivalent volume of total annual snow transport in m^3/m of distance transverse to the wind

R_c = Fetch distance in m

P_r = Water-equivalent (m) of winter snowfall swept off the fetch zone

R_m = Defined as 3050 m for southeastern Wyoming

Evaporation losses from snowdrifts, losses to soil water recharge, and losses during transport from the drift to use sites, are a significant portion of total drift water content. These losses must be considered and minimized where possible, when designing snow management projects.

Onsite snow retention can be increased on rangelands by increasing vegetation height. Increased snow retention results in greater soil water recharge thereby benefiting site productivity. Planting forage grasses that are taller than native vegetation in a stripping pattern is one method of increasing snow retention. Grass strips must be oriented perpendicular to prevailing wind direction. The interval between strips should be about 20 times grass height to insure that the drift cast by grass strips extends across undisturbed rangeland vegetation.

* David L. Sturges, Research Forester, Rocky Mountain Forest and Range Experiment Station, 222 South 22nd Street, Laramie, Wyoming 82070.

PAPERS ORIGINALLY SCHEDULED,

BUT UNABLE TO BE PRESENTED

AT WORKSHOP DUE TO CONFLICTS

Soil-Water-Air Meeting
Rocky Mountain Region
Jackson, Wyoming
February 2-6, 1981

Panel: Bureau-wide Soils Program, Its Purpose and Uses (Thursday, Feb. 5)

Montana Perspective - M. B. Rollins, State Office Soil Scientist

First of all, where are we now in the program?

The soils on Montana public lands are now 85% mapped (7,250,000 of 8,500,000 acres are covered). At the close of the 1981 field season, they will be about 95% mapped.

The next step is to better identify soil capabilities and limitations that were not identified during the soil inventory. In other words, to gather soil characterization data.

In most cases, this will be a matter of gathering additional physical, chemical and mineralogical data on key, typical soils. In addition, we are collecting data on soil water behavior, nutrient behavior and vegetative production, ground cover and erosion condition.

These kinds of data will serve as the basis of implementing appropriate management according to the capabilities and limitations of the soils. This has been the primary purpose of the soils program, to supply basic support data.

Since we are already involved in soil characterization, our soils program in Montana can slip into monitoring very smoothly. Monitoring seems to be the next natural step. Fortunately, the public land in Montana is about covered with a soil survey, at least for the first time around. Near completion of the soil surveys will aid implementing monitoring programs related to the basic soil resource.

It is noteworthy that Montana agencies involved in the national cooperative soil survey, headed by state government and spawned by state law, are sponsoring a program that is very similar to BLM's program in the state. That is, following soil mapping, additional data is collected to further identify the potentials and constraints of the state's soils.

What should the program be?

Basically, the Bureau soils program is going in the right direction. Its primary purpose should be to provide support data for other activities.

The program, however, could function more effectively if it had a little more autonomy. For example, the conclusion reached by Dr. James Pomerening in his recent analysis of the Bureau's soil program (August 1980), was that the Bureau's soil program needs its own office at the Washington level and, in my opinion, its own budgeting channel. In other words, since we provide support data for nearly all BLM programs, soils needs a program and budgeting system that reflects this broad support.

In addition, as an important basic resource, management of the soil has a lot to do with application of multiple use and sustained yield principles. As soil scientists, we need to move the program solidly in that direction.

How is soil data being used?

Soils data in Montana has been used most in the range and coal programs. In range, soils are being used to identify range sites and vegetative production potentials. It is too early to determine the extent of soils use in implementing grazing management. Hopefully, soils data better defining a broad range of basic resource potentials and constraints will be used to supplement effective management.

The coal program is using soils in assessing reclamation potential and in planning effective rehabilitation of surface mined lands. The assessment of overburden by soil scientists is also an important part of the coal program.

The timber program is using soils data in assessing timber production capability and in location of roads and trails.

The wildlife program in Montana, however, has not yet discovered the use of soils data. It seems they are happy with their own program. Also, soil scientists have been busy with priority programs and have not yet had the time, nor taken the time, to assist the wildlifers in the use of soils data; perhaps we need some good examples on how other states have been successful.

Soil information delivery should be improved.

Computer storage and delivery of soils data offers a great tool. The emphasis should be on integrating soil resource inventories with land use potentials, evaluations and decisionmaking. Several data banks already established could provide necessary biological, physical and location data. Alternative management systems can be evaluated in terms of economics, energy efficiency and environmental quality. Computer generated maps can identify areas that, for example, are similar productivity or environmentally, thereby facilitating the extension of inventory and monitoring results and the transfer of technology.

Where do we go from here?

Since most of the public land we manage is range land, range therefore has a dominant influence upon Bureau policies; let's look at this for a minute from a soils point of view.

Our past land management policies have been based upon the Taylor Grazing Act. I draw attention to the portion giving direction "to stabilize the livestock industry." We all have heard range people cite this particular portion of that Act. It is my feeling that this reasoning was a primary cause for leasing the same number of AUMs year in and year out; often under season-long use. We are all aware this has not been a sound practice. Little attention was given to the capabilities or limitations of the basic resources.

We are now under a new law, the Federal Land Policy and Management Act, giving us new direction and charges. Salient to the soils program are the charges to manage the land under "multiple use" and "sustained yield" principles.

Court orders requiring ESs for livestock grazing, as well as coal mining, have had even a greater immediate impact upon the Bureau's soil program. This impact, however, has been primarily positive. It has caused us to get our soil inventories completed, or well under way. Otherwise, we would have been a long time in getting these inventories completed. The livestock grazing court order has also caused us to gather data on vegetative production, present and potential.

These inventories have given the range program data with which to allocate vegetation. But it appears this allocation still has the superficial influence of the Taylor Grazing Act "to stabilize the livestock industry", i.e., allocate the same amount of vegetation each year.

If our vegetation production data doesn't do anything else, it will demonstrate to us that not every year is a favorable year for productivity. This is a large part of understanding the capabilities and limitations of the basic resources. Each soil has a certain vegetative production capability that is influenced by a diversity of variables and they are not the same every year. This brings us to a major point.

We need to manage our land on the basis of each individual year's productivity; if it's there, it can be used, if it isn't (i.e., such as in a drought year), then it cannot be used. We cannot remove last year's vegetation to satisfy an annual vegetation allocation. In other words, we must manage more on the basis of using target ground cover levels sufficient to protect the basic productivity of the soil - this is the essence of sustained yield.

We are apt to find that such a system will be the most realistic way to protect the basic soil resource from abuse and thereby insure sustained yield, as the law charges; and, in addition, aid in stabilizing the livestock industry and other multiple land uses.

Analytical Reliability in the Decision Making Process - The Numbers Game

by

Richard McQuisten

Purpose:

The purpose of this paper is to encourage that consideration be given by those with Environmental Data and Monitoring responsibilities to improve the reliability of the data base from which environmental decisions are made, through implementation of Quality Assurance programs.

INTRODUCTION

In response to a 1977 Presidential directive to the Council on Environmental Quality, CEQ, an Interagency Task Force was developed to review present Federal environmental monitoring and data collection programs and to recommend effective improvements. The Federal Government depends upon the analyses that result from such programs to guide sound policy and decisions; which effect the public health and welfare and result in large annual expeditures of funds by all levels of government and the private sector. During the past few years, the adequacy of several major Federal environmental and data collection programs have been found to be deficient.

Although concern about the reliability of analytical results has always existed, this concern has come more into focus because of the growing interest and activity in environmental pollution control; with its heavy reliance on and analytical results for enforcement, regulation and litigation. This concern is primarily due to the inherent limitations in the conduct and analysis of analytical measurements. Certainly since there are no absolutes in analytical results, it is necessary to recognize that some indication of value or reliability of the results is needed.

Consistent with the subject of this meeting is the consideration of establishing a quality assurance program for land management activities. Although quality assurance is a concern in all activities and programs, it's importance is most appropriately discussed within the context of air and water resources.

Air and water measurements (index values) relate to the state of a system at a particular place and time. It is not possible to perform verifying measurements at some later time because of the inherent spacial and temporal variability. Additionally, if a sample is collected and analyzed, the nature of the sample is often changed in the process (water quality dynamics). Because of the impossibility of verifying past measurements, quality assurance can only rest on documented application of proven methodology by qualified personnel following accepted guidelines on sampling design.

Anyone active in the environmental field appreciates the importance of accurate measurements. Many important environmental issues require that difficult decisions be made on the basis of data taken at numerous monitoring stations over long periods of time. For example; long term changes in climate cannot be assessed without precise and accurate baseline data on wind, precipitation, solar radiation, temperature, spacial and temporal varibility, etc., from many monitoring stations. Congruently, if it is necessary to measure temperature with a total uncertainty of ± 0.5°C for verification of climatic models or long term trends, then one must make very sure that the accuracy (not just the precision) of the temperature measuring system (not just the sensor) is better than ± 0.5°C.

Simply, we must be prepared to provide accurate quantitative answers to questions such as "How much variability, both in space and time, is there from one measurement system in one location to another nominally equivalent system in another location?", and consequently, "What is the significance of the differences observed in the two locations?".

Reliance on Numbers

Our present day society has increased its reliance on numbers to staggering degrees. This can generally be attributed to our increase in technological capability and refinements in data collection and processing. Computer technology has increased our ability to utilize quantitative techniques to the extent that once complex, time-consumming calculations can now be done in a matter of seconds. With this increased capability has come an almost sacred reliance on the number, (as an absolute value, |x|). Many of us use numbers without regard to their origin, reliability, or limitations. Numbers can be useful, or they can be quite devastating--depending upon how they are generated and interpreted or misinterpreted. It is incumbent, then, upon the resource specialist (the originator of the "number") to identify and quantify all the factors which affect the precision and accuracy of measurements, identify inherent variability and uncertainties in the sampling and analyses process and to establish a monitoring system which will detect important environmental changes.

Precision, Accuracy and Significance

Technology is advancing so rapidly that many basic concepts are not adequately understood nor applied to the depth required by present day needs. Some research efforts have become so acutely focused on details that application to the basic problem becomes lost. So it is with numbers. Too many, numbers are presented without regard to the user needs (those who must interpret or understand them). This often results in confusion, wasted effort and loss of credibility. Nothing confuses a concept like the person who uses but does not fully understand the generated number. Numbers must be understood in terms of precision, accuracy and significance.

Precision measures mutual agreement amoung individual measurements, usually under prescribed similiar conditions[1]. It describes reproducibility, independent of accuracy. Several factors affect the precision of an analytical measurement. Included are sensitivity to sample contamination, knowledge and skill of observer, error contribute by the sampling device and natural influences in the system. Equally important is the ability to obtain a representative sample aliquot for each replication.

Accuracy is the degree of agreement of a measurement with an accepted reference or true value[1]. In the determination of precision, a comparison of known results of one sample, e.g. water quality analyses, is made relative to other known sample results. However, in determining the accuracy of a measurement, a comparison of known sample results of a water quality analysis to some unknown quality of a given constituent, e.g., calcium ion in a water sample, is made.

Significance is a difficult, complex, and frequently misused concept. An evaluation of precision and accuracy of a measurement leads to an understanding of significance; whether it refers to a change in water quality, a violation of a water quality standard, etc. Basic statistical analyses, i.e. sensitivity, reliability, corrulation, and error, provide the prime means for evaluating, (significancy determination) a number.

Validity of a Number

A numbers usefulness depends upon some given level of confidence. A measurement system can be inaccurate and imprecise having both random and systematic errors. It can be precise but inaccurate having systematic errors. It can be accurate and precise having neither random or systematic error. Before placing a great deal of confidence in it, the user must consider the makeup of the number. Validation of the number requires several types of information. A few examples are:

- Was appropriate and adequate sampling equipment used?
- Were sampling procedures described in detail?
- Were precautions to avoid sample contamination established?
- Were appropriate techniques used in selecting sampling sites?

- o Were replicate samples taken in order to define sampling variablity?
- o Were background samples taken?
- o Was the sampling frequency and duration adequate and appropriate to the purposes of the project?
- o Was the sampling program designed to assure all samples are representative of the source?
- o Was the sampling method commensurate for intended application, i.e., is it too accurate or not accurate enough?
- o Did the analytical methods measure the appropriate variable and result in data of adequate detection limit (accuracy and precision commensurate with project requirements)?
- o Were the results reported correctly, (with no typographical errors and with correct units assigned)?
- o Were samples preserved to prevent changes between the times of collection and analysis?
- o Were the analytical methods able to overcome suspected interferences in the samples?
- o Were the personnel making the measurement qualified to do so?

In principle, a generated number can be accurate and imprecise; however, if the imprecision is high there is no way to reasonably test the accuracy. Ideally one would like to be able use a number which is both accurate and precise. However, since this ideal situation is seldom achieved, it becomes necessary to define an acceptable level of confidence in the data. A conceptual design for hierchial parameter confidence is expressed in Table 1. (These are arbitrary values, meant only to provide an exemplary data use categorization). Ultimately, though, the goal should be to combine all parameters to determine a confidence in all data generated for a specific analysis report in order to define the usefulness of the reports conclusions.

Table 1: Data Use Categorization for Each Parameter

Confidence Limit	Use
>95%	General Purpose, Litigation, etc.
>85%	General Purpose, etc. Except Litigation
>65%	Reports, with Qaulifications
<65%	Information Purposes or Discard

Combined Numbers

Typically, use of numbers is not single purpose oriented. In land management practices, it is common to make various biological measurements. These measurements generally are not used until they are combined with other data to provide some type of information which will ultimately lead to a land management recommendation. An example of this would be the determination of livestock grazing capacity. A determination of this type relies on vegetation measurements, livestock use, and climiatic data. Rarely do the final capacity figures include an indication of uncertainty of the numbers that were used in making the determination, due to possible measurement errors. This places the decision maker in a tenuous position of not knowing the significance of the capacity figure so that reasonable adjustments to the carrying capacity can be made.

Another example involves determination of soil loss using soil loss equations. Most of these equations were empirically developed for use on cultivated crop lands and are now being applied to other areas such as rangelands. These equations are made up of a number or parameters including precipitation, erodability, length of slope, steepness of slope and ground cover. The individual parameters measured generally do not have a known degree of associated error specified. Any one of the parameters can have considerable variability, which may result from multiplicative, divisional or exponential error, causing the production or estimate from the equation to have a high degree of unreliability.

Therefore, use of combined data must be carefully assessed and presented, relative to it's end use, or a correct final result may not be reached.

Over-Extention

Over-extention is the practice of developing conclusions on data of limited range and/or application. While many over-extended conclusions may be correct, over- extention becomes serious when critical decisions are based upon incomplete, inaccurate or limited analyses. Usually it presents a far more credible description than is actually the case, for example, extrapolation beyond the range of values in a regression equation. Application of over-extention causes a false sense of security to those who depend on the information developed to make a decision. To avoid over-extention, one must as a minimum qualify assumptions and conclusions developed from such data.

Some of the best examples of over-extention can be found in environmental analyses and impact statements. Often these documents are required to quantify impacts on the environment using qualatative data. To be quite colloquial, they often use "space-age analysis with horse and buggy data".

Traceability

The word traceability causes much confusion because it is one of those words that means different things to different people. Citing of traceability requirements by regulatory agencies, for environmental measurements, is common. For example, the Environmental Protection Agency invokes traceability requirements in it's "Hazardous Waste Guidelines and Regulations" [40 CFR Part 250], December 18, 1978.

Interpretations of traceability have sometimes focussed on the documentation of instrument calibration rather than on the accuracy of the measurements. For example, one may have a "widgit" detector properly and accurately calibrated, but if it is improperly used, the data it produces will be worthless. The point to be made here is that calibrated instruments are usually a necessary, but often not a sufficient condition, for demonstrating traceability. Many factors besides the quality and accuracy of the instruments used will effect the accuracy of the measurements, including the procedures used, skill and training of the operator, environmental conditions, etc. Traceability cannot be achieved until it can be shown that the actual measurements produced by the measurement process are, on a continuing basis, accurate relative to national or other established (specified) standards[3].

Faulty Analysis

Faulty analysis, like over-extention, is an error on the part of the person generating the number. However, unlike over-extention, faulty analysis usually has acceptable data but poor application of analysis techniques. If a method is selected which is inappropriate for the situation being investigated, inaccurate results will occur. Unless thorough knowledge of the factors affecting various methods is evaluated, inappropriate method selection may result. Since almost all measurements and/or samples represent a unique set of conditions, it is difficult to establish a standard method that can be applied to all situations. Lack of descriptive controls resulting in misinterpretation of good data is an additional reason for faulty analysis. A good example of this situation can be seen in many research projects where even though proper study designs and analysis technques were used, the project conclusions are invalid because good and bad data can be used interchangably.

Problem Solutions

To this point this discussion has attempted to define the problem of using imprecise, inaccurate, unvalidated, unreliable, misinterpreted data and to some degree limitations in using derived numbers. As a means of solution, it is suggested that utilizing good quality assurance/quality control procedures will provide the sought for level of acceptability. Quite likely in the near future, as a result of the CEQ Task Force report on Quality Assurance (mentioned in the introduction) and draft legislation presently in Congress, each Federal Agency responsible for monitoring programs will be required to establish its own quality assurance program.

Of importance to all Agencies and their programs is the Environmental Protection Agency's (EPA) Policy. EPA requires participation by all EPA Regional offices, Program Offices, EPA Laboratories, and States in a centrally-managed quality assurance (QA) program and includes all monitoring and measurement efforts mandated or supported by EPA through regulations, grants, contracts, or other formalized means not currently covered by regulation[1].

What is a QA Program?

Quality assurance (QA) encompasses all actions taken by an organization, attempting to answer the basic question: How valid, accurate, and reliable are the reported results for the undertaken programs?

The terms quality assurance (QA) and quality control (QC) are often used synonymously, although they represent two distinct concepts. EPA has established the following definitions[1]:

Quality Assurance (QA) - the total integrated program for assuring reliablity of monitoring and measurement data.

Quality Control (QC) - the routine application of procedures for obtaining prescribed standards of performance in the monitoring and measurement process.

The primary goal of a QA program is to insure that all environmentally related measurements result in data of known quality. To meet this goal, the QA program must provide for the establishment and use of reliable monitoring and measurement systems to meet planned organizational needs, i.e. research, demonstration and monitoring. "Practically", the purpose of a QA program is really to provide intelligible accountability to management.

A QA program can succeed only if it is given attention by top management and sufficient authority and resources to accomplish established program objectives are provided. Implementation of a QA program depends, in large measure, upon the development of general management plans for each distinct program area along with explicity detailed plans for each individual project or study. It is essential to understand the difference between these two plans.

QA Program Plans are written documents which include the overall policies, organization, objectives, and functional responsibilities designed to achieve data quality goals for the activities for which the particular organization is responsible[2].

QA Project Plans are written documents, presenting in specific terms, the policies, organizations, objectives, functional activities, and specific QA and QC activities designed to achieve the data quality goals of a specific project(s) or continuing operation(s)[2].

Essential elements in a QA program plan are:

- Management Policy Statement
- Organizational and Management Structure
- Resources
- Project Design
- Personnel Qualifications
- Facilities, Equipment, and Services
- Sampling and Data Generation (QA project Plans)

- Implementation Requirements and Schedules
- Data Management and Processing
- Data Quality Assessment and Summarizations
- Corrective Action

Conclusions

The importance of measurements required by environmental analyses and regulations is becoming increasingly recognized. The inherent concern is detecting significant changes resulting from a proposed action. Results of our analyses, as investigators, plays an extremely crucial role in the entire environmental process. Therefore, we need to be more concerned with using representative data in determining changes in environmental conditions, emphasising identification of natural variability, monitoring of real changes and traceability to accepted standards. As generators of numbers we are responsible for the end-products of data analyses, and we must be cognicant of the many problems that can be encountered when numbers are poorly generated. Briefly stated, we must be assured of the credibility and integrity of the number generated for the decision making process.

Acknowledgements

The author wishes to express his appreciation to Jim Westhoff, DOE-Laramie Energy Technology Center; Karl Gebhardt, DOI-Bureau of Land Management for their invaluable assistance; and to Patrick Green, Bruce Van Haveren, Rich Herbert, and Cliff Franklin, DOI-Bureau of Land Management for their valued review.

References

1. Guidelines and Specifications for Preparing Quality Assurance Program Plans, Environmental Protection Agency, Draft April 29, 1980.

2. Strategy for the Implementation of the EPA's Mandatory Quality Assurance Program, EPA, QAMS-001/80, March 11, 1981.

3. The NBS Role in Quality Assurance for Physical Measurements, Belanger, Brain C., et. al., Paper presented at the National Conference on Quality Assurance; Denver, Colorado, November 27-29, 1978.

GENERAL REFERENCES

1. Proceedings from the National Conference on Quality Assurance of Environmental Measurements; Denver, CO, November 27-29, 1978.

2. Quality Assurance Guidelines for IERL-CI Project Officers, EPA-600/9-79-046, December 1979.

3. Statistical Quality Control, E.C.Grant, et.al., 4th edition, MaGraw Hill, Inc., 1972.

4. Handbook for Analytical Quality Control In Water and Wastewater Laboratories, EPA-600/4-79-019, March 1979.

5. Data Quality Assurance Guidelines for Marine Environment Programs, U.S. Department of Commerce, March 1980.